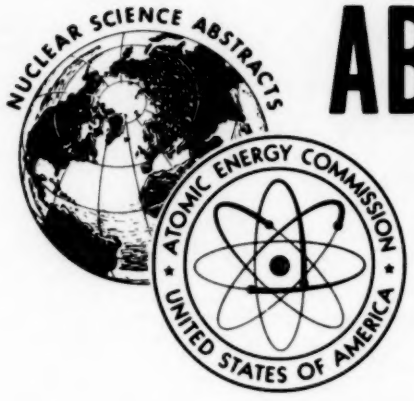
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 5

Abstracts 9724-12493

March 15, 1974

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NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

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All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

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AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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Volume 29, Number 5 March 15, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 10639 and 12411.

9724 NUCLEAR TECHNIQUES FOR ENVIRONMENTAL STUDIES. Whitley, J. E. (Scottish Research Reactor Centre, Glasgow). Trans. Soc. Occup. Med.; 22: No. 4, 126-129(Oct 1972).

A review is presented of the advantages of nuclear techniques in analysis of environmental samples. The following techniques are discussed: use of radioactive reagents for isotope dilution analysis and isotope derivative analysis; use of stable isotopes; neutron activation analysis; radiochemical analysis; and non-destructive analysis by means of examination of spectra of gamma rays emitted by an irradiated sample. (HLW)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 9904, 10871, and 11483.

9725 (AERE-R-7563) TWO NOMOGRAMS FOR GAS CHROMATOGRAPHY CALIBRATIONS. Hurdus, M. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Two nomograms are described which enable rapid calculation of impurity gas concentrations during calibration of a gas chromatograph using an exponential dilution flask. (auth)

9726 (BMFT-FBK-73-22, pp 145-149) DETERMINATION OF PLATINUM IN BORON-CONTAINING GLASSES BY NEUTRON ACTIVATION ANALYSIS. Menke, H.; Weber, M. Aug 1973. (In German).

In annual report, 1972.

9727 (CEA-CONF-2309) CONTROL OF THE QUALITY OF NUTRIENTS BY ANALYSIS OF MINERALS IN PLANT MATERIAL. Gountchev, C.; Fourcy, A.; Bechard, M.; Bittel, R.; Schaal, D. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 10p. (In French). (CONF-7210101-1). Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on cooperation and industrial promotion of control and quality in the food industry; Sofia, Bulgaria (28 Oct 1972).

The radioactivation technique for determination of heavy element and fluoride contamination of nutrients is outlined. Some examples are given of the results obtained by radioactivation analysis of farinas, grapes, and raisins for Br, As, and Hg and for fluorine pollution of several vegetables from different regions. (JSR)

9728 (CEA-CONF-2330) CONCERNING THE DETERMINATION OF TRACES OF OXYGEN AND CARBON IN SODIUM OR CESIUM BY MEANS OF ACTIVATION ANALYSIS. Engelmann, C.; Nordmann, F.; Tinelli, G (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Ecole Superieure de Chimie, Mulhouse (France)). 10 Apr 1973. 18p. (In French). (CONF-730449-2). Dep. NTIS (U. S. Sales Only) $3.00.

From BNES international conference on liquid alkali metals; Nottingham, UK (4 Apr 1973).

Methods developed and used for the determination of very low concentrations of carbon and oxygen in sodium and cesium are described. These elements can be determined by activation analysis by means of bremsstrahlung γ photons. The nuclear reactions used are $^{16}O(\gamma,n)^{15}O$ and $^{12}C(\gamma,n)^{11}C$. Oxygen and carbon lead respectively to ^{15}O and ^{11}C with half-lives of 2.03 and 20.3 min after activation. This allows a cleaning after irradiation and then an elimination of all contamination of the metal by its container or the ambient medium. This method has the advantage of needing no blanks if the experimental conditions, particularly the maximum irradiation energy, are well chosen. The chemical separation procedures used are described. Numerous results are given of the determination of oxygen and carbon in sodium and cesium. The methods developed make it possible to determine for the first time the oxygen and carbon concentrations as low as 0.3 $\mu g/g$ in sodium. (tr-auth)

9729 (CEA-CONF-2331) IMPORTANCE AND ROLE OF NUCLEAR CONSTANTS IN ACTIVATION ANALYSIS USING CHARGED PARTICLES OR γ PHOTONS. Engelmann, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 19 Jan 1973. 25p. (In French). (CONF-730302-16; SM-170/66). Dep. NTIS (U. S. Sales Only) $3.25.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

The principle and the area of application of activation analysis with charged particles and photons are reviewed briefly. The calibration methods in which nuclear constants intervene are described. The influence of competitive nuclear reactions in causing analytical errors is discussed. The importance of the knowledge of the thresholds and of the excitation functions of the thresholds and of reactions by which the analysis is done is deduced. The interest of the compilations of certain nuclear constants, notably the definition of optimum irradiation conditions, is shown. Compilations designed directly for these techniques and which permit a knowledge of the exact possibilities of the method are justified. (tr-auth)

9730 (CONF-720920-) SECOND INTERNATIONAL CONFERENCE ON FORENSIC ACTIVATION ANALYSIS, GLASGOW, 27-29 SEPTEMBER 1972. Text of Papers. (Western Regional Hospital Board, Glasgow (UK). Dept. of Clinical Physics and Bio-Engineering). 1972. 596p.

Thirty-three papers presented at the conference are included. Separate abstracts were prepared for 29 papers. Four papers were previously abstracted for NSA. For abstract numbers of these papers see CONF-720920 in the Report Number Index. (LK)

For abstracts of individual papers see: 9731-9758 and 9829.

9731 (CONF-720920-, pp Paper 1, 1-6) ARSENIC CONTENT OF HAIR AND BONES IN THE CASE OF THE SUSPECTED POISONING OF R. BRUN, FIRST MAYOR OF THE CITY OF ZURICH. Wyttenbach, A.; Bajo, S.; Hug, E. (Eidgenoessisches fuer Reaktorforschung, Wuerenlingen, Switzerland). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Hair and bones taken from the grave of R. Brun were examined by neutron activation analysis to give support to the hypothesis that Brun was poisoned. The arsenic content of the hair is below the mean value for healthy people. The bones had an abnormally high arsenic content. Arsenic in the soil from the tomb was leachable with water and it was concluded that the high arsenic content in the bones was caused by the bones being in contact with the soil. (LK)

9732 (CONF-720920-, pp Paper 3, 1-11) DETERMINATION OF GUNSHOT RESIDUES BY NEUTRON ACTIVATION ANALYSIS.

Menke, H. (Johannes Gutenberg Univ., Mainz); Leszczynski, C.; Weber, M. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Determination of firing distances is sometimes important in criminal cases involving shooting. Traces of antimony, barium, and lead from the cartridge primer are deposited around the bullet hole. Neutron activation analysis of these residues can be done with great sensitivity. (LK)

9733 (CONF-720920-, pp Paper 4, 1-11) EXAMINATION OF EVIDENCE MATERIALS FOR ENVIRONMENTAL CONTAMINATION USING ACTIVATION ANALYSIS. Pillay, K. K. S.; Thomas, C. C. Jr.; Mahoney, G. F. (State Univ. of New York, Buffalo). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis for W, Co, and Ta was performed on physical evidence samples from a homicide-criminal assault case. The results from the analysis were accepted by the court and resulted in a conviction. (LK)

9734 (CONF-720920-, pp Paper 5, 1-14) STATISTICAL COMPARISON OF TRACE ELEMENT CONCENTRATIONS. Liebscher, K. (Univ., Glasgow). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

A method is proposed by which the significance of the differences between trace element concentrations of sample and control can be estimated without detailed knowledge of the distribution in the total population. Both sample and control are cut in half and the trace element concentrations of all four pieces are determined. The concentration values of the two halves of each sample are compared with each other and so are the concentration values of the two samples. This cross-comparison is essentially the application of Student's t-test to the smallest possible number of data. The calculation is reduced to a simple formula, and tables of confidence limits are not needed. The implications of lack of general background knowledge are discussed. Since it cannot always be known whether a certain trace element follows a normal or log-normal distribution pattern, or whether simultaneously determined concentrations of several trace elements are correlated with each other, the most cautious estimate of the significance is recommended. (auth)

9735 (CONF-720920-, pp Paper 6, 1-15) GUNSHOT RESIDUES ON PARAFFIN DROPS: INSTRUMENTAL ACTIVATION ASSAY OF ANTIMONY, BARIUM AND COPPER. Borra, G.; Brandone, A.; de Bernardi, G.; Fornari, A.; Orvini, E.; Rollier, M. A. (Univ., Pavia, Italy). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

In the attempt to make easier the removing of gunpowder residues from the skin, a simplified method was tested as compared to the one commonly used of brushing with liquid paraffin. The removing material is still paraffin, but it is dropped from a lighted paraffin-candle on the first interdigital space of the hand. Building maps for gunpowder residues of hands who fired a pistol the first interdigital space was found to be the most significant. Analyzing the paraffin "blanks" from candles they were found free from antimony, barium, and copper. Next a lot of samples from the left and right hands of individuals who did and did not fire a pistol were examined. The results clearly show that from the content of Sb, in first place, and also of Ba, it is possible to identify the person who fired the pistol. Due to the random distribution of copper coming from the skin, this element appears not to be meaningful for the identification of shooters. Some practical cases of suicides and shooters are reported. (auth)

9736 (CONF-720920-, pp Paper 8, 1-9) NEUTRON ACTIVATION ANALYSIS AND TOXICOLOGY. Smith, H. (Univ.; Glasgow). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis, a well-established method for detection and estimation of elements, has been applied to forensic toxicology where the interest is in the detection of the elements in human tissue. These elements may be present in the following categories: necessary for life, normal environmental contaminants present by chance, abnormal environmental contaminants present by chance, deliberate exposure for medical reasons, deliberate exposure for homicidal reasons, and direct external contamination from the environment. Application of neutron activation analysis to these categories is discussed. (LK)

9737 (CONF-720920-, pp Paper 9, 1-15) COLLECTION AND ACTIVATION ANALYSIS OF AIRBORNE GUNSHOT RESIDUES. Renfro, W. B.; Jester, W. A. (Pennsylvania State Univ., University Park). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Determination of location and time a weapon has been fired is important in criminal investigations. Lack of physical evidence increases the difficulty in determining the location. A technique for collecting and analyzing airborne gunshot residues is described. The technique is sufficient to detect the firing of the major brands of U.S. ammunition through neutron activation of the barium and antimony particles that a revolver firing expels into the air. The sensitivity of detection is at least 72 hr after firing. Precise determination of time of firing is not possible, but gross estimates can be made. (LK)

9738 (CONF-720920-, pp Paper 11, 1-24) STUDIES OF GUNSHOT RESIDUE. Gislason, J.; Pate, B. D. (Simon Fraser Univ., Burnaby, B. C.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The deposits resulting from the discharge of 0.22 calibre ammunition have been studied by neutron activation analysis and autoradiography. Material ejected forward with the bullet and material ejected between a revolver cylinder and barrel have been collected on filter paper and on a variety of clothing fabrics. The extent of the deposits has been studied visually, by soft x-ray radiography and by autoradiography following neutron activation; the latter revealed features not visible by other techniques. The elemental composition of a number of discrete features of the deposit pattern was then determined by neutron activation analysis and compared with the composition of deposits obtained by primer firings alone, from the burning of propellant, and from the analysis of bullet lead. The preliminary identification of the various deposit components is discussed, together with the forensic implications. (auth)

9739 (CONF-720920-, pp Paper 12, 1-34) VARIATION OF TRACE ELEMENT CONCENTRATIONS IN SINGLE HUMAN HEAD HAIRS. Obrusnik, I.; Gislason, J.; Maes, D.; McMillan, D. K.; D'Auria, J.; Pate, B. D. (Simon Fraser Univ., Burnaby, B. C.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The concentrations of nine trace elements in segments of individual human head hairs have been determined by neutron activation analysis. Concentration variations have been studied along individual hairs, among hairs plucked from various locations on the scalp, among hairs in different phases of the growth cycle, and before and after hair cleaning. Recent atomic absorption analysis data indicate strong concentration fluctuations in successive single hair segments of 2 to 5 mm in length. The results are discussed in a forensic context. (auth)

9740 (CONF-720920-, pp Paper 13, 1-16) STUDIES OF THE TRACE ELEMENT CONTENT OF BULLET LEAD AND JACKET MATERIAL. Guy, R. D.; Pate, B. D. (Simon Fraser Univ., Burnaby, B. C.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The technique of instrumental neutron activation analysis, involving neutron fluxes of 10^{14} n cm^{-2} sec^{-1} and high-resolution Ge(Li) γ detectors, has been applied to the analysis of bullet lead and jacket material. Radiochemical separation of the majority of the radioantimony from the irradiated bullet material was performed, with the objective of facilitating measurement of other elements present. Eight elements were measured in bullet lead and four in jacket material. Concentration variations between the varieties of ammunition studied indicate that more extensive studies, directed to possible ammunition characterization, would be worthwhile. (auth)

9741 (CONF-720920-, pp Paper 14, 1-13) NONDESTRUCTIVE EXAMINATION OF ROMAN SILVER COINS BY NEUTRON ACTIVATION ANALYSIS. van Dalen, A.; Das, H. A.; Zonderhuis, J. (Reactor Centrum Nederland, Petten). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The detection of "plated" specimens (ancient falsifications consisting of a copper core with a silver outer layer) amidst a great collection of silver coins was performed by nondestructive neutron activation analysis. The "plating" can be detected by measuring the Ag/Cu ratio. In practice it is more convenient to determine the Au/Cu ratio which is proportional to it. A short activation in a low thermal neutron flux is sufficient for this purpose. Consequently the induced activity of the long-lived ^{110m}Ag is small. The necessary correction of self-absorption on the measured ratio is small. A series of 2000 coins was analyzed in this way. (auth)

9742 (CONF-720920-, pp Paper 15, 1-8) FORENSIC ACTIVATION ANALYSIS: THE AUSTRALIAN SCENE. Goulding, J. H. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Facilities and equipment available and the analysis procedures used in Australia are discussed. Analysis of gunshot residue for antimony and barium is used as an example. (LK)

9743 (CONF-720920-, pp Paper 16, 1-14) ACTUAL CASE OF EXAMINATION OF COUNTERFEITED WHISKY. Lima, F. W.; Silva, C. M.; Guimaraes, R. Jr. (Instituto de Energia Atomica, Sao Paulo, Brazil). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis was used to detect counterfeited scotch. Empty bottles from imported scotch were filled with locally made scotch and sold at the imported price. Bottle caps and samples of the spirit were analyzed. (LK)

9744 (CONF-720920-, pp Paper 17, 1-8) MERITS AND DEMERITS OF FORENSIC ACTIVATION ANALYSIS WHEN COMPARED TO OTHER TRACE ANALYSIS METHODS. Krishnan, S. S. (Centre of Forensic Sciences, Toronto, Ont.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis, atomic absorption spectrophotometry, x-ray fluorescence, and emission spectrography are compared as trace analysis methods for forensic applications. The types of material examined include hair, bullet alloys, metal fragments, gunshot residues, and heavy metal poisons. When only three or four elements are involved qualitative analysis can be done quickly using x-ray fluorescence and emission spectrography and quantitative analysis by atomic absorption. For accurate determination of more than four elements, neutron activation analysis is used. (LK)

9745 (CONF-720920-, pp Paper 18, 1-11) IDENTIFICATION OF SAFE-PACKING MATERIALS. Evans, D. J. R. (Atomic Energy of Canada Ltd , Chalk River, Ont.); Kennedy, P. L.; Bergh, A. K. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis can identify 10-20 elements in characteristic safe-packing materials, and comparisons of the activation "fingerprints" of samples offer a very good prospect for positively or negatively matching two or more samples. (LK)

9746 (CONF-720920-, pp Paper 19, 1-17) PATTERN RECOGNITION AS A STATISTICAL METHOD FOR ANALYZING THE CONFIDENCE LEVEL IN THE IDENTIFICATION OF OBJECTS. de Bruin, M. (Interuniversitair Reactor Inst., Delft, Netherlands); Korthoven, P. J. M.; Duin, R. P. W.; Groen, F. C. A.; Bakels, C. C. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

A combination of trace-element analysis by neutron activation and pattern recognition yields satisfactory results in the classification of mineral samples on the basis of trace-element pattern. In a pattern recognition procedure, each sample is represented by a point in a multidimensional concentration space. From the analytical data of groups of training samples from various relevant origins, the multidimensional probability distribution for each origin can be constructed. Then, an unknown sample can be assigned to a specific origin which provides the highest probability for the occurrence of such a sample. The position of the sample in the probability distribution of the assigned origin yields information about the confidence level of the identification. (LK)

9747 (CONF-720920-, pp Paper 21, 1-14) BARIUM AND ANTIMONY LEVELS ON HANDS: SIGNIFICANCE AS INDICATOR OF GUNFIRE RESIDUE. Experience With Neutron Activation Analyses on Coroner's Cases. Gerber, S. R.; Pro, M.; Cowan, M. E.; Purdon, P. L.; Hoffman, C. M.; Brunelle, R.; Lundgren, F. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The presence of barium and antimony on hands can be determined by neutron activation analyses on paraffin handlifts of the person. The levels of barium and antimony present can be indicative of gunshot residues. How or when the deposition of residue occurred must be ascertained from other information. (LK)

9748 (CONF-720920-, pp Paper 22, 1-16) EXPERIENCE WITH THE METHOD OF AUTORADIOGRAPHY FOR FIRING DISTANCE DETERMINATION. Schmitz, J. (Geseilschaft fuer Kernforschung m.b.H., Karlsruhe, Ger.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Both the quantitative determination of antimony in the firearm discharge residue and the making visible of the residue pattern around the bullet hole play a role in the determination of firing distance. For a certain combination of firearm and ammunition, definite characteristic distributions arise from which the firing distance is calculable by purely visual comparison. When contamination is suspected, the autoradiograph plays a vital role. The stripping technique allows the carrier and residue to be separated without disturbing the characteristic distribution. This technique is indispensible when the carrier exhibits strong matrix activity. The method is in addition nondestructive (i.e., the targets remain intact as evidence. (auth)

9749 (CONF-720920-, pp Paper 23, 1-19) FACTORS AFFECTING THE TRACE-METAL CONTENT OF HUMAN HAIR. Gordus, A. A. (Univ. of Michigan, Ann Arbor). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Variables that might affect the trace-metal content of human hair are sample preparation, physical factors, external factors, and personal factors. The hair samples were analyzed by neutron activation analysis; trace elements determined were Al, Ca, Cr, Mn, Cu, Zn, As, Se, Br, Sb, I, Au, and Hg. (LK)

9750 (CONF-720920-, pp Paper 24, 1-26) EVALUATION OF TRACE ELEMENT ANALYSIS IN THE FORENSIC INVESTIGATION OF FIBRE SAMPLES. Bush, H. D. (Bradford Univ., Eng.); Butterworth, A.; Pearson, E. F.; Pounds, C. A. 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

A forensic scientist must be able to identify the class to which a fiber belongs, and he may be required to identify a type of fiber within a particular class and to relate a particular fiber to one of a number of garments made from the same type of fiber, but which contain different chemical finishing agents. The use of trace element analysis to discriminate between different types of fiber within two classes of fiber (natural and synthetic) was studied by neutron activation analysis of wool and acrylics. (LK)

9751 (CONF-720920-, pp Paper 26, 1-25) GROWTH OF HAIR AND THE TRACE ELEMENT PROFILE: A STUDY BY SECTIONAL ANALYSIS. Gangadharan, S.; Lakshmi, V. V.; Das, M. S. (Bhabha Atomic Research Centre, Bombay). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Correlations between the growth of hair and the trace-element profile have been investigated by nondestructive neutron activation analysis through gamma spectrometry using NaI(Tl) as well as Ge(Li) detectors. After preliminary investigations to establish the experimental errors, the effect of washing procedures and in-person variations, hair samples belonging to ladies with known case histories, particularly in regard to dietary habits, health, and profession, were examined. Scalp-hair samples 50-100 cm in length, representing an average time span of ~5-10 years, were collected by combing. Samples in their non-anagen phase, differentiated by their roots, were analyzed in 10-cm sections. The concentrations of the following elements have been determined: Na, Cl, Mn, Co, Cu, Zn, As, Se, Ag, I, Au, and Hg. Absolute values for the concentrations are reported for most of the elements while for the rest, relative values for the various sections are given. The values for the different sections vary by large factors for many elements although for some elements, like Cu and Mn, the variations are not appreciable. The unusually large concentrations of elements like Se and Hg are in broad agreement with the case histories. However, detailed examination of the results in regard to time-dependent variations seems to pose serious problems in the applications to forensic science. (auth)

9752 (CONF-720920-, pp Paper 27, 1-19) NEUTRON ACTIVATION ANALYSIS OF HAIR. Failure of a Mission. Cornelis, R. (Univ., Ghent, Belgium). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The trace elements (Zn, Cu, Au, Hg, As, Sb, Mn) present in hair are not constant and their concentrations are not as specific as has been suggested. The concentration and dispersion of zinc remain essentially constant, and copper has a certain degree of stability; however, Hg, Au, As, Sb, and Mn vary considerably. Because of factors that are not controllable a given sample of hair cannot be related to a given individual by neutron activation analysis. (LK)

9753 (CONF-720920-, pp Paper 28, 1-20) NEUTRON ACTIVATION ANALYSIS OF DENTAL METALS IN THE VIEW OF FORENSIC ODONTOLOGY (DENTAL IDENTIFICATION). Roetzscher, K.; Mende, S.; Flachowsky, J.; Geisler, M.; Wehran, H.-J. (Karl-Marx-Univ., Leipzig). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

In cases of complicated identification (e.g., burn victims), further

clarification can be obtained by using neutron activation analysis to examine dentures or teeth. Prior to 1930, Au, Ag, Cu, and Pt were used for dental purposes exclusively; present day alloys used in denistry are not limited to these metals. (LK)

9754 (CONF-720920-, pp Paper 29, 1-9) DIFFERENCES IN TRACE-ELEMENT CONCENTRATIONS IN HAIR BETWEEN MALES AND FEMALES. Verghese, G. C.; Kishore, R.; Guinn, V. P. (Univ. of California, Irvine). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The findings of an exploratory forensic-environmental study of the levels of certain trace elements in human head hair from persons living in or near Orange County, California (i.e., in the vicinity of the University of California at Irvine) are reported. Hair specimens from more than one hundred persons from this region were analyzed for Hg, Au, and Zn via instrumental thermal-neutron activation analysis. As will be shown, quite significant differences in the levels of Hg and Au (especially mercury), between male head hair and female head hair, were observed, whereas no such difference was observed in the zinc levels. The likelihood that the differences in the Hg levels (and perhaps the Au levels) between the sexes are due to differences in the degree of external contamination from hair-treating agents is discussed, and the forensic implications of these findings are also discussed. (auth)

9755 (CONF-720920-, pp Paper 30, 1-35) NUCLEAR ANALYSIS APPLICATIONS IN COOPERATIVE TEXAS FORENSIC INVESTIGATION PROGRAM. Gage, S. J.; Whitworth, J. B. (Univ. of Texas, Austin). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

For the past two years, a cooperative nuclear forensic investigation program has been in operation in the Nuclear Reactor Laboratory at the University of Texas at Austin. An essential partner in this program has been the Crime Laboratories of the Texas Department of Public Safety. Under this program, both routine analyses of typical physical evidence samples and comprehensive survey analyses of classes of materials with forensic importance have been carried out. Both radioisotope-excited nondispersive x-ray fluorescence and multi-element instrumental neutron activation analyses have been used, the first technique for screening incoming samples and performing macro-constituent analyses and the second for performing quantitative trace element analyses. Close coordination of routine analyses with the Crime Laboratories has provided supportive and complementary analyses of physical trace evidence samples for the preparation of investigative results. Carefully selected survey projects, such as the trace elements characterization of safe plasters and shotgun pellets, have contributed to the development of background data available for forensic analysis in other laboratories. (auth)

9756 (CONF-720920-, pp Paper 31, 1-18) TRACE ELEMENT DISTRIBUTIONS IN MAN-MADE FIBERS. Vogt, J. R.; Hashii, D. M. (Univ. of Missouri, Columbia). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The technique of neutron activation analysis was investigated as an additional method for characterization of man-made fibers. The six types of fibers used in this study were acetate, acrylic, nylon, modacrylic, polyester, and rayon. The following elements were determined quantitatively in one or more of the 51 samples studied: Ti, Sr, An, Sb, Br, Mg, Cu, V, K, Al, Mn, Cl, Na, Ca, In, S, Co, and Zn. (LK)

9757 (CONF-720920-, pp Paper 32, 1-30) COMPARISON OF GLASS FRAGMENTS BY NEUTRON ACTIVATION ANALYSIS. Coleman, R. F.; Goode, G. C. (Atomic Weapons Research Establishment, Aldermaston, Eng.). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Neutron activation analysis was used to compare glass fragments. The following elements were determined: Al, As, Ba, Ca, Co, Cr, Ce, Eu, Fe, Hf, La, Lu, Mg, Mn, Na, Rb, Sb, Sa, Sr, Th, and Yb. The concentration of uranium in each sample was determined by a delayed neutron technique. Results indicate that multi-element analysis is a discriminating method for comparing glass fragments. (LK)

9758 (CONF-720920-, pp Paper 33, 1-10) RECENT SIGNIFICANT U.S. COURT CASES INVOLVING FORENSIC ACTIVATION ANALYSIS. Guinn, V. P. (Univ. of California, Irvine). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Recent court cases involving activation analysis data are discussed. Cases involving technical errors, interpretive errors, and good analyses and interpretations are included. (LK)

9759 (EURISOTOP-87) DETERMINATION OF CARBON AND NITROGEN IN SILICON AND GERMANIUM. Gebauhr, W.; Martin, J. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Aug 1973. 75p. (In German). Dep. NTIS (U. S Sales Only) $5.75.

The technical significance of the determination of C and N in Si and Ge is outlined, and the economic importance of the determination is discussed. Analysis techniques, including activation analysis, for the determination of small concentrations of C and N are then reviewed. The detection limits of these elements in Si and Ge are discussed. (JSR)

9760 (INIS-mf-718) NEUTRON-ACTIVATION ANALYSIS OF CHLORINE-CONTAINING PESTICIDES IN SOILS AND TOBACCOS. Dimchev, T.; Gunchev, Kh. (Komitet za Mirno Izpolzvane na Atomnata Energiya, Sofia (Bulgaria); Akademiya na Selskostopanskite Nauki, Sofia (Bulgaria)). 1972. 14p. (In Bulgarian). INIS.

From second national conference on uses of radioisotopes and ionizing radiation in biology and agriculture; Sofia, Bulgaria (28 Nov 1972).

A nondestructive method was developed for determining the total residue levels of chlorine-containing pesticides in soils and farm produce. For accurate determination of organically bound chlorine in the different objects, preliminary inorganic extraction, neutron activation, and gamma spectrometry are applied. Formulas are deduced for computing data from two spectrometric measurements. Quantitative determinations are conducted by activation of standard preparations treated in the same way under the same conditions. The method was applied successfully for determining chlorine-containing pesticide residues from Lindan and DDT in experimental samples of soils and tobaccos. Repeated determinations are carried out with a view to establishing the repetition of the results from the analysis. The method offers wide opportunity for application in other biologic objects as well. (INIS)

9761 (JINR-P12-7447) EXPRESS INSTRUMENTAL-ACTIVATION DETERMINATION OF HALOIDS AND MERCURY BY ^{199m}Hg ISOMER. Duda, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

For excitation of the ^{199m}Hg isomeric state ($T_{\frac{1}{2}}$ = 43 min) the (n,n') and (n,2n) reactions of fast neutrons (E_n = 14 MeV) of the neutron generator NG-200 were used when bombarding ^{199}Hg and ^{200}Hg nuclei with the neutron fluxes of the order of 2 to 6×10^8 n/cm^2·sec. Halides were determined by the ^{19}F(n,p)^{19}O, ^{35}Cl(n, 2n)^{34m}Cl, ^{79}Br(n,2n)^{78}Br and ^{127}I(n,2n)^{126}I reactions. With the exception of iodine, the limits of the detection of these elements, when determining them simultaneously on 0.1 - 0.2 g samples, were in the range of 1 to 7×10^{-4} g. For 300 - 15 - 300 sec regime the determination sensitivity was 139 cpm/mg (Cl), 351 cpm/mg (Ng), 375 cpm/mg (Br) and 398 cpm/mg (F). The determination duration, without taking into account the sample preparation, was 15 min. (auth)

9762 (STI/PUB-322) IN VIVO NEUTRON ACTIVATION ANALYSIS. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, Austria, April 17–21, 1972. (International Atomic Energy Agency, Vienna (Austria)). Sep 1973. 248p. (CONF-720471-). IAEA $11.00.

Separate abstracts were prepared for 20 of the 25 papers presented in these proceedings. Four of the other papers are represented by abstracts only. An abstract of the remaining paper was published in Vol. 28 of NSA as abstract number 26959. (ERB)

For abstracts of individual papers see: 9777–9794, 10454, and 10565.

9763 DEPTH PROFILES OF ALUMINUM AND SODIUM NEAR SURFACES: NUCLEAR RESONANCE METHOD. Dunning, K. L.; Hubler, G. K.; Comas, J.; Lucke, W. H.; Hughes, H. L. (Naval Research Lab., Washington, DC). Thin Solid Films; 19: No. 1, 145-156(3 Dec 1973).

Depth profiles of aluminum and sodium implanted into silicon carbide, silicon and silicon dioxide were measured by means of sharp resonances in the reactions ^{27}Al(p, γ)^{28}Si and ^{23}Na(p, γ)^{24}Mg. The absolute number of impurity atoms was determined and compared with that indicated by charge integration during implantation. Adjacent areas of some specimens were measured by the Cameca ion-beam mass spectrometer and the nuclear resonance method; results are compared. A depth resolution of less than 20 Å was demonstrated for Al very near the surface of SiC. Information concerning the migration of sodium in SiO_2 under ion bombardment is presented. Depth profiles are extracted from gamma-ray yield curves taking into account the beam energy distribution, the resonance shape, the average proton energy loss in the sample and the energy loss straggling. (auth)

9764 DETERMINATION OF THE FLUORIDE CONCENTRATION PROFILE IN TOOTH ENAMEL USING A NUCLEAR RESONANCE TECHNIQUE. Mandler, J. W.; Moler, R. B.; Raisen, E.; Rajan, K. S. (IIT Research Inst., Chicago). Thin Solid Films; 19: No. 1, 165-172(3 Dec 1973).

The $^{19}F(p, \alpha\gamma)^{16}O$ reaction was used to measure the concentration profile of fluorine in tooth enamel. By observing the characteristic 6.13 MeV γ ray with a high resolution Ge(Li) detector, the fluorine concentration was measured to a depth of 2.1 μm in teeth treated with K_2ZrF_6, NaF and acidulated fluorophosphate. The differential depth resolution was better than 0.1 μm at the surface of the teeth. Additional information on the average elemental concentration within the first 2 μm was obtained by observing the characteristic x-rays produced by 1.8 MeV protons. The exploratory data developed in this study have indicated that the highest uptake of fluoride was achieved through the application of K_2ZrF_6. (auth)

9765 MEASUREMENT OF BORON DISTRIBUTION IN ^{10}B-IMPLANTED SILICON BY THE (n,α) NUCLEAR REACTION. Mezey, G. (Central Research Inst. for Physics, Budapest); Szoekefalvi-Nagy, Z.; Badinka, C. Thin Solid Films; 19: No. 1, 173-175(3 Dec 1973).

The $^{10}B(n,\alpha)^7Li$ reaction was used to determine implanted boron profiles in silicon samples. Instead of a surface barrier detector plastic foils were used and a depth resolution of 230 Å was achieved by combining the method with anodic stripping. This technique allowed the determination of quite low energy boron profiles. (auth)

9766 INVESTIGATION OF THE γ SPECTRA OF SUBCELLULAR FRACTIONS IRRADIATED IN THE NEUTRON FLUX BY THE HIGH RESOLUTION Ge(Li) DETECTOR. Mosulishvili, L. M.; Mandzhgaladze, V. P.; Kuchava, N. E. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 65-68(Oct 1973). (In Russian).

Results of the deciphering of γ radiation of subcellular fractions irradiated in the neutron flux of a nuclear reactor by the high-resolution Ge(Li) detector are shown. The sensitivity of determination of Sc, Cr, Fe, Co, Zn, Se, Rb, Sb, Hg was calculated. By using the high-resolution Ge(Li) detector the above-mentioned elements in one (5 to 10) mg specimen of subcellular fractions may be simultaneously determined. (auth)

9767 NEUTRON-ACTIVATIONAL DETERMINATION OF RUBIDIUM IN GEORGIAN RED WINES. Devdariani, T. G.; Beridze, G. I.; Zakharov, E. A.; Macharashvili, G. R.; Daneliya, G. I. Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 161-164(Oct 1973). (In Russian).

The content of Rb in Georgian red wines was determined by instrumental neutron activation. The content of Rb in the wines studied was found to vary from 0.44 to 1.78 mg/liter. The feasibility of simultaneous determination of Si, K, P, Mg, Fe, Na, and Rb by the same method was demonstrated as well. The experiment was carried out in the NGI-8 generator, employing the Ge(Li) detector. The flow of neutrons was $5 \cdot 10^7$ neutron/cm$^2 \cdot$ sec; exposure time 15 min.; detection threshold 0.01 mg. (auth)

9768 DETERMINATION OF MACRO- AND MICROELEMENT CONTENT IN LUNAR SOIL SUPPLIED BY THE AUTOMATIC STATION LUNA-16. Adam, I.; Frana, Ya.; Mashtalka, A.; Tsimbalnikova, A.; Palivtsova, M. (Inst. of Nuclear Physics, Rez, Czech.). Geokhimiya; No. 9, 1287-1293(Sep 1973). (In Russian).

With the aid of a nondestructive neutron activation analysis the content of 27 elements in 12 fragments of lunar rocks (3 microgabbro, 1 basalt, 4 breccia, 3 sinters, 1 scoria) and in the fine-grained regolith fraction (<0.05 mm) supplied by the automatic station Luna-16 was determined. A great difference between the chemical composition of primary lunar rocks of basalt type and the chemical composition of secondary lunar rocks (breccia and scoria) was observed. The dependence of the relative content of some elements in the rocks, gabbro, basalt, breccia, and scoria was studied. (auth)

9769 NONDESTRUCTIVE ACTIVATION ANALYSIS OF ARAB CRUDE OILS. Zaghloul, R.; Obeid, M.; Staerk, H. (Technische Univ., Munich). Radiochem. Radioanal. Lett.; 15: No. 6, 363-372 (19 Dec 1973).

Determination of vanadium, sulfur, sodium, and bromine in Arab petroleum oils is based on activation of samples by neutrons. Gamma activity was measured by a multichannel γ spectrometer with Ge(Li) detector and NaI(Tl) crystal. The amount of vanadium, bromine, sodium, and sulfur ranged from 9.52 to 51 ppM, 0.15 to 0.36 ppM, 0.06 to 0.31 ppM, and 1.2 to 3.1%, respectively. (auth)

9770 USE OF INORGANIC ION EXCHANGERS IN THE NEUTRON ACTIVATION DETERMINATION OF ARSENIC IN COAL ASH. Santoliquido, P. M. (Illinois State Geological Survey, Urbana). Radiochem. Radioanal. Lett.; 15: No. 6, 373-377(19 Dec 1973).

Irradiated coal ash samples were fused with NaOH, dissolved, and acidified so that the resulting solution was 7M in HNO_3. From this medium, carrier-free amounts of arsenic were retained on columns of acid aluminum oxide or hydrated manganese dioxide. The latter is preferred because it has a greater loading capacity. Low-temperature ashes of six Illinois coals have been analyzed with both exchangers. Results compare well with those obtained by an acid dissolution-distillation separation method. (auth)

9771 APPLICATION OF EPITHERMAL NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF INDIUM AND CADMIUM IN BLENDES, INTERFERENCE OF MANGANESE. Cohen, I. M. (Comision Nacional de Energia Atomica, Buenos Aires). Radiochem. Radioanal. Lett.; 15: No. 6, 379-385(19 Dec 1973).

The advantage of using epithermal irradiation for the determination of indium and cadmium, when large manganese contents are present is discussed. Application to instrumental analysis of blendes is shown. Results for manganese, indium, and cadmium in twenty samples are included. (auth)

9772 COMPARISON OF SURFACE LAYER ANALYSIS TECHNIQUES. Mayer, J. W.; Turos, A. (California Inst. of Tech., Pasadena). Thin Solid Films; 19: No. 1, 1-10(3 Dec 1973).

A comparison is given of the microanalytical techniques for measurement of concentration profiles (0.01 to 10 μm) that have been presented at the International Conference on Ion Beam Surface Layer Analysis. These techniques include Auger electron spectroscopy, secondary ion mass spectroscopy, beam generated x-rays and photons, the electron microprobe, low and high energy back-scattering, and nuclear reactions. In general, techniques that measure the composition of the outermost layers can possess high sensitivity but absolute measurements are difficult. Depth profiling is not satisfactory because sputtering processes are not yet under control. Analyses with high energy ion beams provide quantitative measurements and depth profiles with relative ease, but generally at reduced levels of sensitivity. These two classes of techniques thus furnish complementary methods of surface layer analysis. (29 references) (auth)

9773 SIMPLE METHOD FOR SIMULTANEOUS RADIOCHEMICAL SEPARATIONS IN ACTIVATION ANALYSIS. Csajka, M. (Central Research Inst. for Physics, Budapest). Anal. Chim. Acta; 68: 31-36(1974).

A radiochemical separation technique is described, which permits several elements or groups of elements to be isolated in a single step from the activated sample and from one another. The inexpensive apparatus considerably simplifies radiochemical procedures for activation analysis. It was used for the simultaneous separation of copper and rare earth activities from irradiated rock samples. (auth)

9774 DETERMINATION OF NICKEL IN ROCKS AFTER EPITHERMAL NEUTRON ACTIVATION. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Anal. Chim. Acta; 68: 25-30(1974).

Nickel has been determined in seven U.S.G.S. standard rocks by reactor activation analysis based on the $^{58}Ni(n,p)^{58}Co$ reaction. Irradiation in cadmium containers is used in order to reduce interference from nuclides formed by (n,γ) reactions. Samples with nickel contents down to a few ppM can be analyzed instrumentally by Ge(Li) γ spectrometry, but considerable improvements is observed by introducing a simple radiochemical separation. The data obtained are compared with previous literature values. The method is applicable to most geological samples. (auth)

9775 DETERMINATION OF TRACE ELEMENTS IN COAL BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Block, C.; Dams, R. (State Univ., Ghent). Anal. Chim. Acta; 68: 11-24(1974).

A completely instrumental neutron activation analysis, with Ge(Li) γ spectrometry and computer-assisted data reduction, has been developed for the measurement of more than 40 elements, including Dy, I, Eu, Sm, Ce, La, Sc, Th, Cs, Lu, Yb, and Mo, in coal samples. Two neutron irradiations and 3 to 5 γ-spectrometric measurements are performed for each sample. Sensitivity and reproducibility of the analysis and homogeneity of the samples were investigated. The overall standard deviation for nearly all elements is determined by the counting statistics. (auth)

9776 MULTI-ELEMENT SERUM STANDARD FOR NEUTRON ACTIVATION ANALYSIS. Cornelis, R.; Speecke, A.; Hoste, J. (State Univ., Ghent). Anal. Chim. Acta; 68: 1-10 (1974).

A multi-element serum standard containing the elements

Ag, Co, Cr, Cs, Fe, Hg, Rb, Sb, Se and Zn, which is suitable for long irradiations at high neutron flux, is described. Tests showed that the homogeneity of the doped serum is satisfactory even for sample sizes of 20 mg. The accuracy obtainable with the proposed standard was demonstrated by analysis of the N.B.S. SRM 1577 bovine liver. (auth)

9777 CURRENT STATUS AND CLINICAL POTENTIAL OF IN VIVO ACTIVATION ANALYSIS. Fremlin, J. H.; Chamberlain, M. J. (Univ. of Birmingham, Eng.). pp 13-22 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The current status and clinical potential of in vivo neutron activation analysis techniques for the measurement of total-body calcium are reviewed, the choice of neutron source that will give the least variation in neutron flux and the choice of induced radioactivity measurement system that will give the least variation in detection efficiency throughout the human body being discussed in detail. Results obtained of serial measurements of total-body calcium in various pathological conditions are presented and the clinical value of these results is assessed. The value of corresponding techniques for the measurement of other elements in the human body is discussed, ant the results of phantom studies in the authors' laboratory aimed at investigating the feasibility of measuring total-body nitrogen and trace amounts of the toxic element cadmium in terms of the prompt γ rays emitted during activation of these elements are presented. (auth)

9778 NEUTRON SOURCES, ENERGY, FLUX DENSITY, AND MODERATION IN TOTAL-BODY NEUTRON ACTIVATION ANALYSIS. Cohn, S. H.; Fairchild, R. G.; Shukla, K. K. (Brookhaven National Lab., Upton, NY). pp 37-47 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Homogeneity of irradiation and uniformity of counting of the induced radioactivities are two essential requirements for in vivo neutron activation analysis. Factors involved in achieving homogeneous irradiation: namely choice of neutron sources, energy, flux density distribution, and moderators are reviewed in detail. The neutron sources that can be employed include accelerators of various types, nuclear reactors, and radioactive sources, such as ^{238}Pu–Be, as well as spontaneous fission sources such as ^{252}Cf. The choice of neutron energy depends on the element to be activated, the uniformity of neutron flux density required, and the acceptable radiation dose to the subject. The advantages and disadvantages of the various neutron sources in these regards are discussed. (auth)

9779 NEUTRON SOURCES, ENERGY, FLUX, AND MODERATION IN THE BODY. Boddy, K. (Scottish Universities Research Reactor Centre, Glasgow). pp 49-64 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Eight factors on which the choice of neutron sources for in vivo neutron activation analysis depends are listed. Available neutron sources and their neutron outputs, irradiation geometries, and the uniformity of neutron flux that they provide along the length of the body are reviewed. The moderation of neutrons in the body and the variation of neutron flux through its depth are discussed. The interfering reactions in the measurement of the five major elements in the body—calcium, sodium, chloride, phosphorus, and nitrogen—by in vivo neutron activation analysis are discussed. Finally, the relative costs of neutron sources for in vivo neutron activation analysis are considered. (auth)

9780 ESTIMATION OF THYROID GLAND IODINE CONTENT BY IN VIVO ACTIVATION. Comar, D.; Riviere, R.; Kellershohn, C. (Service Hospitalier Frederic Joliot, Orsay, France). pp 69-78 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The general requirements for the estimation of the iodine content of the thyroid gland in vivo by neutron activation analysis and the present status of techniques for such estimations are reviewed. Of two groups undertaking such estimations one uses a collimated beam of fission neutrons including fast, intermediate and thermal neutrons, the other a beam of fully thermalized neutrons. In the former case, irradiation of the gland is considered to be homogeneous. In the latter, irradiation is non-homogeneous but techniques to correct for this non-uniformity based on the use of ^{128}I as an internal standard were developed. Both NaI(Tl) scintillation counters and Ge(Li) semiconductor counters have been used for measurement of the induced radioactivity, the improved energy resolution of the latter offering advantages. The radiation dose to the subject in these techniques is not higher than that which is usually accepted in medical diagnosis. (auth)

9781 REVIEW OF THE TECHNIQUE OF MEASURING THE INTRATHYROIDAL CONTENT OF IODINE IN MAN BY IN VIVO ACTIVATION ANALYSIS. Boddy, K. (Scottish Universities Research Reactor Centre, Glasgow); East, B. W.; Robertson, I.; Alexander, W. D.; Wilson, G. M. pp 79-86 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The technique for measuring the intrathyroidal content of iodine in man by in vivo neutron activation analysis is reviewed. The irradiation conditions are discussed, especially as regards uniformity of neutron flux activation, beam size, and induced radioactivity per unit radiation dose. The method of monitoring of induced radioactivity is also discussed. The validity of the use of ^{129}I as an internal standard is considered in detail. (auth)

9782 ESTIMATION OF IRON CONTENT IN THE LIVER. Short Contribution. Oxby, C. B. (General Infirmary, Leeds, Eng.). pp 89-90 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The iron content in the liver of patients undergoing renal dialysis was determined by in vivo neutron activation analysis. In the procedure, the liver was irradiated with unmoderated 14 MeV neutrons with a dose of about 10 rem using the fast neutron reaction ^{56}Fe(n,p)^{56}Mn. (auth)

9783 ESTIMATION OF THE TOTAL-BODY SODIUM AND CHLORINE CONTENT. Tomlinson, R. W. S. (King's Coll., London). pp 91-103 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The basic methodology of the few groups of investigators who have used in vivo neutron activation analysis for the determination of total-body content of sodium and chlorine is reviewed. The results obtained by the different groups are compared and the overall results obtained by neutron activation analysis related to the results obtained, sometimes simultaneously, by isotope dilution analysis and to those reported in the literature and obtained by chemical analysis. At the present time sufficient evidence is available to state that total-body sodium is approximately 80 g Na/70 kg body weight and that 80% of this is exchangeable. The results for chlorine are still too scarce to make comparable statements. The neutron activation analysis method is obviously preferable to chemical analysis and is the only one at present applicable to measurement of total-body contents on patients. The method requires further investigation, however, before it can be routinely used for the determination of total-body sodium and chlorine. (auth)

9784 IN VIVO NEUTRON ACTIVATION ANALYSIS MEASUREMENT OF NON-EXCHANGEABLE SODIUM IN NORMAL MAN. Rudd, T. G.; Nelp, W. B. (Univ. of Washington, Seattle). pp 105-110 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

A method of estimating total-body non-exchangeable sodium in vivo by neutron activation analysis is described. The subject is given total-body neutron irradiation. After a delay of 5 h to allow induced radioactivity due to nuclides other than ^{24}Na to decay, induced ^{24}Na radioactivity is measured by means of a whole-body counter. Urine is then collected for 20 h and the specific activity of the urinary sodium, representing the exchangeable sodium compartment, measured. After a further delay of 48 h, a known amount of ^{24}Na is injected intravenously for a determination of exchangeable sodium by dilution analysis. Urine is collected for 24 h after which the whole-body counter measurement of ^{24}Na is repeated, a spot urine sample collected and the specific activity of the urinary sodium again measured. The method allows the estimation of total-body sodium and hence of non-exchangeable sodium, without the use of phantoms for calibration purposes. Results of estimations in five normal subjects, indicating that approximately 27% of the body sodium is non-exchangeable, are presented. (auth)

9785 HUMAN BODY COMPOSITION STUDIES. I. Neutron Activation of Total-Body Hydrogen and Whole-Body Counting. Carlmark, B.; Reizenstein, P. (Karolinska Hospital, Stockholm). pp 113-126 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

A neutron activation analysis method for measuring total-body hydrogen in vivo based on measurement of the 2.23 MeV prompt γ rays from activated hydrogen is described. The body is irradiated at a neutron flux of approximately 10^4 n/s from two 10 mCi ^{241}Am-Be sources moving along it simultaneously with the two 5 in. dia. × 3 in. NaI(Tl) crystal scintillation detectors. The activation is continued for 2000 s and the patient receives a radiation dose of less than 3 mrem. Special boron–paraffin shielded neutron applicators are used so that fast neutrons from the generators do not reach the detectors directly. The results must be corrected for the non-uniformity of the neutron flux and for variations in the body shape. Correction curves were constructed, based on the estimated average thickness and width of assumed, 16 cm long "slices" of the human body. Phantom measurements indicated a coefficient of variation in the values thus corrected of only 2.9%. To examine the significance of total-body hydrogen in relation to body composition, the total-body water and potassium were also measured. The total bone mass was estimated on the basis of skeletal measurements. Ten healthy volunteers had statistically significant correlations between total-body hydrogen and total-body water, and also between total-body hydrogen and total-body potassium, suggesting that the method proposed is valid at least in normal subjects. Fifteen patients with obesity were also examined. Here there was no significant correlation between the total-body hydrogen and the potassium, probably because of the large amounts of fat, which contains hydrogen but little potassium. However, reliable results can be obtained in all cases if the method is combined with some other simple method such as skinfold thickness measurement. (auth)

9786 ESTIMATION OF TOTAL-BODY PHOSPHORUS AND NITROGEN IN VIVO. Palmer, H. E.; Nelp, W. B. (Battelle Pacific Northwest Lab., Richland, WA). pp 127-133 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The present status of techniques for the measurement of total-body phosphorus and nitrogen by in vivo neutron activation analysis and their clinical application is reviewed. The method currently used to measure total-body phosphorus employs fast neutrons to produce ^{28}Al from ^{31}P. At the present time the main interest in total-body phosphorus arises from the possibility of its use as a substitute for total-body calcium as an index of total-body bone mass. Analysis of calcium and phosphorus in cadavers shows a constant ratio of these elements, indicating that there is no problem in using the phosphorus content in bone as a measure of bone mass. The advantages and disadvantages of using phosphorus content rather than calcium content for this purpose and the problem of correcting results of total-body phosphorus measurements for extraskeletal phosphorus are discussed. Two methods are currently used to measure total-body nitrogen. The first of these employs fast neutrons to produce ^{13}N from ^{14}N. In the second and more recent method, the prompt γ-rays emitted when ^{14}N captures thermal neutrons are measured, the irradiation and counting measurement being carried out during alternating short periods. The advantages and disadvantages of the two methods are discussed. The interest in total-body nitrogen arises from the direct relationship between the nitrogen and protein content of the body. Total-body nitrogen may be a useful parameter in clinical studies of a variety of diseases that affect protein metabolism. (auth)

9787 PRELIMINARY RESULTS OF MEASURING TOTAL-BODY PHOSPHORUS AND NITROGEN WITH A NEW FACILITY FOR TOTAL-BODY IN VIVO ACTIVATION ANALYSIS. Boddy, K.; Holloway, I.; Elliott, A. (Scottish Universities Research Reactor Centre, Glasgow). pp 135-137 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Preliminary studies of the use of a relatively simple facility constructed especially for clinical applications of in vivo neutron activation analysis in total-body phosphorus and nitrogen measurements are presented. Results of measurements with an Alderson phantom indicate that it should be possible to measure total-body phosphorus by this means with an overall reproducibility (standard deviation) of ± 3.15% and total-body nitrogen with an overall reproducibility of 2.63%. Consideration of the relative counting rates due to phosphorus and nitrogen indicates that the component standard deviation due to variation in neutron fluence and that due to variation in detection efficiency for induced radioactivity are about equal. (auth)

9788 ESTIMATION OF TOTAL CALCIUM CONTENT BY IN VIVO ACTIVATION ANALYSIS. Ackers, J. G. (Reactor Centrum Nederland, Petten). pp 141-150 of In Vivo Neutron Activation Analysis. Vienna: International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Physiological and physical aspects of the measurement of total-body calcium by in vivo neutron activation analysis are discussed. Relevant data on the distribution of calcium in the human body, stable and radioactive calcium isotopes, and their neutron reactions are presented. Analytical methods based on the measurement of delayed γ rays emitted during decay of induced radioactivity, and methods based on the measurement of prompt γ rays emitted during activation, are considered in general terms and the potential accuracy is assessed. (auth)

9789 ESTIMATION OF TOTAL CALCIUM CONTENT. Guey, A. (Hopital de l'Antiquaille, Lyon). pp 151-162 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The use of in vivo neutron activation analysis for the estimation of total-body calcium is reviewed. The relevant physical properties of calcium isotopes, the choice of neutron source, the parameters of the irradiation, including estimation of radiation dose absorbed by the tissue, and experimental procedures employed, the choice of method for measuring the induced radioactivity, and the expression of the results are discussed. Three disadvantages that need to be overcome before the method can be used routinely are listed. (auth)

9790 PRELIMINARY RESULTS OF MEASURING TOTAL-BODY CALCIUM WITH A NEW FACILITY FOR TOTAL-BODY IN VIVO ACTIVATION ANALYSIS. Boddy, K.; Holloway, I.; Elliott, A. (Scottish Universities Research Reactor Centre, Glasgow). pp 163-169 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

A relatively simple facility constructed especially for clinical applications of in vivo neutron activation analysis is described and the results of preliminary studies of its use in total-body calcium measurements presented. Neutron irradiation is carried out with two opposed sealed-tube neutron generators, the body of the subject passing between these on a motorized couch. Measurement of induced radioactivity is carried out with two opposed lead-shielded sodium iodide crystal scintillation detectors, the body of the subject again passing between them on the couch. By making the speed of movement of the body of the subject identical in each case differences in decay of induced radioactivity between irradiation and measurement are automatically compensated. Results of measurements on an Alderson phantom and a polyethylene phantom indicate that it should be possible to measure total-body calcium by this means with an overall reproducibility (standard deviation) of ± 1.90%. (auth)

9791 COMPARISON OF TECHNIQUES FOR THE TOTAL-BODY NEUTRON ACTIVATION ANALYSIS OF CALCIUM IN MAN. Cohn, S. H.; Fairchild, R. G.; Shukla, K. K. (Brookhaven National Lab., Upton, NY). pp 173-184 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

There is general agreement that total-body neutron activation analysis is the only currently available method by which a precise and accurate measurement of the total bone mass may be made. The techniques used by three groups of investigators in carrying out such measurements are reviewed. Neutron sources and source subject geometry, uniformity of neutron flux density in the irradiated subject, use of moderator, measurement of induced ^{49}Ca radioactivity in the body, and interpretation of results in terms of absolute calcium content are discussed in detail, as well as radiation dose to the subject. It is pointed out that in vivo neutron activation analysis techniques based on the use of (α,n) neutrons offer numerous advantages over techniques based on the use of neutrons produced by cyclotrons or neutron generators. (auth)

9792 OBSERVATIONS ON TOTAL-BODY CALCIUM MEASUREMENTS BY IN VIVO ACTIVATION. Nelp, W. B.; Palmer, H. E. (Univ. of Washington, Seattle). pp 193-200 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Experiences in the field of total-body calcium measurement by in vivo neutron activation analysis are described. A rotational technique is used for irradiation of the subject with cyclotron-produced neutrons. The induced radioactivity is measured by means of a circular array of scintillation detectors surrounding the body and the results compared with those obtained with a calcium-containing phantom. These arrangements were found to give satisfactory reproducibility. Measurements of induced radioactivity in cadavers of varying body size followed by chemical determinations of total-body calcium indicate a significant variation in induced radioactivity per gram of calcium with body size. The reasons for this variation are discussed. Serial measurements of total-body calcium were carried out together with calcium balance studies in various pathological conditions. The significance of the results obtained is discussed, both in relation to the normal values of total-body calcium as a function of age and body size and in relation to other clinical and biochemical evidence of disease. (auth)

9793 ESTIMATION OF PARTIAL-BODY CALCIUM CONTENT. Oxby, C. B. (General Infirmary, Leeds, Eng.). pp 211-216 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The techniques for measuring of partial-body calcium are reviewed. The irradiation conditions of seven research groups are discussed. These groups have clearly demonstrated the feasibility of measuring partial-body calcium by localized in vivo activation. However, there are many questions that arise from the basic problem itself. These questions are listed. (auth)

9794 MEASUREMENT OF PARTIAL-BODY CALCIUM. Boddy, K.; Glaros, D.; Robertson, I. (Scottish Research Reactor Centre, Glasgow). pp 217-219 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Experiments designed to test the feasibility of measuring the content of calcium in sections of bone in vivo by neutron activation analysis are described. In some experiments, bones of the leg, ankle or foot of a human skeleton were subjected to bilateral neutron irradiation using a collimated beam of neutrons from a reactor. Induced radioactivity was measured by means of a large sodium iodide crystal scintillation detector with which the irradiated limb was placed in contact. In other experiments, neutron irradiation was carried out using a ^{241}Am-Be source. Results indicate that meaningful measurements of calcium content should be possible with either type of source. (auth)

9795 STUDY OF THE ATMOSPHERIC AEROSOL OVER THE IVORY COAST AND THE GULF OF GUINEA. Crozat, G.; Domergue, J. L.; Bogui, V.; Fontan, J. (Abidjan Univ., Ivory Coast). Atmos. Environ.; 7: No. 11, 1103-1116(Nov 1973). (In French).

Atmospheric aerosols were sampled on filters in the air near ground level over the Ivory Coast and the Gulf of Guinea. Several elements were measured of filters by neutron activation and γ spectrometry. Correlation tests applied to these elements allow them to be classified in groups of common origin. Study of the sampling collected over the Ivory Coast, along a "North-South" axis, showed an increase of the concentrations of the terrestrial elements, as one passes from the coast to the north of the country. However, no particular increase of the concentrations was observed, in ground level air, when passing from one side of the intertropical front to the other. In the air above the land, concentrations of marine aerosols decrease from the coast forth, especially near it. Daily variations may be noticed for all the elements. The experiments performed in marine atmosphere, over the Gulf of Guinea, show that a high number of the elements measured are of terrestrial origin. (UK)

9796 AUTOMATION OF ACTIVATION ANALYSIS. Iwata, S. (Kyoto Univ., Kumatori, Japan). Bunseki Kiki; 11: No. 1, 3-7 (Jan 1972). (In Japanese).

The purpose of automation of machinery and equipments, processes of activation analysis, problems in the automation of each analytical procedure, and future prospects of automatic activation analysis are considered. Automatic activation analysis consists of five steps; preparation of samples, activation of the samples, automation of chemical decomposition and separation, automation of the measurement of radioactivity, and automation of data processing. Of these steps, most out-of-date is the sample preparation, and effort for its automation is scarcely made. Most difficult in the activation of samples is choice of material for sample holders. In case of the activation in nuclear reactors, use of filter paper for quantitative analysis is usually appropriate. For chemical decomposition and separation, evaporation and dissolution are most frequently adopted. However, it is difficult to automatically dissolve irradiated samples, because many samples, which are soluble before irradiation, become hardly soluble after the irradiation. Problems in the automatic measurement of radioactivity are mostly electronic. The automatic data processing is most studied at present. (JA)

9797 DETERMINATION OF URANIUM ISOTOPIC RATIO ^{235}U/^{238}U IN ENVIRONMENTAL SAMPLES BY NEUTRON ACTIVATION ANALYSIS. Morishima, H. (Kinki Univ., Osaka); Koga, T.; Kawai, H.; Katsurayama, Y.; Tsuruta, T. Hoken Butsuri; 8: No. 3, 153-160(Sep 1973). (In Japanese).

Methods to determine the uranium isotopic ratio ^{235}U/^{238}U by neutron activation analysis were examined. Uranium isotopic ratios in several environmental samples containing small amounts of uranium were determined by these methods. After isolated uranium samples were irradiated with a thermal neutron flux at 3.5×10^{12} n/cm^2 · sec for one hour, the radioactivity of ^{99}Mo + ^{99m}Tc produced from ^{235}U fission and that of ^{239}Np induced from ^{238}U were measured by the following two methods to determine the isotopic ratio ^{235}U/^{238}U: energy spectrum analysis of γ rays with a Ge(Li) semiconductor detector and measurement of radioactivity with a 2π gas-flow counter and a NaI(Tl) scintillation counter after radiochemical isolation by solvent extraction. Comparing the above two methods, it was found that β counting using a 2π gas-flow counter and γ spectrometry gave preferable results with fluctuation below 5% to γ counting using a NaI(Tl) scintillation counter. The isotopic ratios ^{235}U/^{238}U in environmental soil samples collected at Ningyo pass and its neighboring places in Okayama Prefecture and at Muro in Nara Prefecture were found to be in the range of 0.0062 to 0.0075, whereas the ratio in uranyl nitrate hexahydrate was 0.0076 ± 0.0004. (auth)

9798 DETERMINATION OF COPPER, ARSENIC, AND MERCURY IN TOBACCO LEAVES BY NEUTRON ACTIVATION ANALYSIS. Maruyama, Y.; Komiya, K. (Musashi Inst. of Tech., Kawasaki, Japan). Radioisotopes (Tokyo); 22: No. 10, 572-574 (Oct 1973). (In Japanese).

9799 DETERMINATION OF ARSENIC IN TEA PLANT BY NEUTRON ACTIVATION ANALYSIS. Takeo, T.; Shibuya, M. (Tea Research Station, Kanaya, Japan). Chagyo Gijutsu Kenkyu; No. 44, 48-51(Jun 1972). (In Japanese).

The content of As in tea plant was determined by neutron activation analysis. The content of As could not be determined by nondestructive activation analysis, using Ge(Li) γ spectrometer, because the γ peak of ^{76}As on the spectrogram was masked by the γ peak of ^{82}Br, which existed in tea and had very similar γ spectrum. After destruction of tea plant with acid, Br in tea plant was distilled from the acid solution and the γ peak of ^{76}As was evidenced on the spectrogram. From the height of the γ peak of ^{76}As the contents of more than 0.2 μg of As in the tea plant were determined quantitatively. By using the Gutzeit method, As in the tea plant was separated from other elements and two characteristic γ peaks of ^{76}As were figured on the spectrogram. From these spectrograms, more 0.05 μg of As in tea plant were detected quantitatively. (auth)

Chemical and Spectral Procedures

Refer also to abstract 10297.

9800 (AERE-M-2607) DETERMINATION OF CERIUM IN STEEL BY STABLE ISOTOPIC DILUTION. Webster, R. K.; Hughes, T. C.; Gibbons, D. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Nov 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Additions of the rare earth group, particularly cerium, are made to improve the oxidation resistance of high-temperature alloys and have been proposed as deoxidizing and desulfurizing agents in the refining of iron and steel. This note proposes stable isotopic dilution as a method for the determination of cerium in steel and gives the results of a first experimental assessment for concentrations down to 0.1 ppM. (auth)

9801 (CEA-CONF-2414) TWO YEARS OF OPERATION OF THE SHIELDED MICROPROBE: EVALUATION AND THE FUTURE. Bazin, J.; Perrot, M.; Rousset, P.; Vignesoult, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles

Nucleaires). [nd]. 31p. (In French). (CONF-730667-1). Dep. NTIS (U. S. Sales Only) $3.75.

From fifteenth meeting of the committee on hot laboratories of Euratom; Gaesthacht, F. R. Germany (14 Jun 1973).

The preparation of samples for the shielded microprobe is characterized by the special efforts made to guard against contamination. The special precautions taken are described. The problems in the development and maintenance of the microprobe are discussed. Some examples are given of the analysis of fuels (U, UO_2, UO_2-PuO_2) and structural materials. The emphasis in these examples is on qualitative and quantitative analysis conditions: measurement of the background, peak/background ratio, selection of samples, and correction of results. An ensemble of modifications in the preparation cycle which permit the examination of the same sample successively by metallography and then by microanalysis without increasing the risks of contamination are described. (JSR)

9802 (CEA-R-4478) PULSE POLAROGRAPHY IN NONAQUEOUS MEDIA APPLICATION TO THE DETERMINATION OF TRACE ELEMENTS IN PLUTONIUM. Bergey, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Nov 1973. 78p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

The usefulness of pulse polarography for the chemical analysis of plutonium in nonaqueous media is discussed. In the first part of the text, the processes enabling plutonium solutions to be obtained in aprotic solvents having high dielectric constants are described, and a brief review is given of the behavior on a mercury drop electrode and a platinum electrode of plutonium solutions in DMF and DMSO. Indications are given on the possibility of carrying out determinations of trace elements in these solutions. In the second part of the text, a method is proposed for the determination of 15 trace elements in a plutonium matrix. The determination methods are based on solvent extraction and a subsequent direct polarographic examination of the extraction solvents. (auth)

9803 (NLCO-1105) SPECTROCHEMICAL DETERMINATION OF 1 ppM OF Ta AND W IN U_3O_8 USING A CARRIER DISTILLATION METHOD. Pepper, C. E.; Blank, G. R. (National Lead Co. of Ohio, Cincinnati (USA)). Nov 1973. Contract AT(30-1)-1156. 12p. Dep. NTIS $4.00.

Tantalum and tungsten at a 1 ppM concentration are determined directly in U_3O_8 samples using a spectrochemical carrier distillation excitation method. Ta and W have upper specification limits at or near 1 ppM in uranium materials destined to be used as UF_6 feed for the USAEC gaseous diffusion plants. Heretofore, Ta and W could not be determined near the 1 ppM level directly in a U_3O_8 sample. They had to be separated from the uranium by time-consuming chemical or evaporation methods prior to spectrography. A spectrochemical method developed to determine 1 ppM of Ta and W directly in a U_3O_8 sample is described. This level of detection is achieved by using a 600-mg sample in a 3/8 in.-diam pedestal-type electrode. A $AgCl-SrF_2$ carrier is intimately pre-mixed with the U_3O_8. The electrode charge is excited with a 15 amp dc arc for 170 sec. Spectra are recorded in the second order on SA-I plates with a grating spectrograph. Appropriate filtering of the light path is done to obtain acceptable signal/noise ratios for a 0.5 to 20 ppM range. Other volatile fluoride impurities such as Mo, Nb, Sb, Ti, and V can also be determined at the 1 ppM and lower levels simultaneously with Ta and W. (auth)

9804 KINETICS OF GAS-METAL INTERACTION APPLIED TO DETERMINATION OF GASES IN METALS BY THE METHODS OF VACUUM FUSING AND ISOTOPE DILUTION. I. Kinetics Nitrogen Evolution. Vitol, E. N.; Orlova, K. B. (Central Scientific-Research Inst. of Metallurgy and Welding, Leningrad). Zh. Anal. Khim.; 18: No. 9, 1781-1791(Sep 1973). (In Russian).

The interaction of nitrogen with a liquid metal is considered based on a three-step kinetic model. A sorption step has been studied by the isotope exchange method and the kinetics of the nitrogen evolution from the melt in vacuum. It has been shown that the rate of the nitrogen evolution from the metal melt in vacuum is limited by a desorption step. (auth)

9805 PHOTOMETRIC DETERMINATION OF NIOBIUM BY THE FORMATION OF NIOBIUM-MOLYBDENUM BLUE. Zaboeva, M. I.; Surin, I. G.; Serkova, A. V. (Gorky State Univ., USSR). Zh. Anal. Khim.; 18: No. 9, 1736-1740(Sep 1973). (In Russian).

The formation of a blue niobium-molybdenum heteropolycomplex in the interaction of niobium with molybdenum(VI) and molybdenum(V) was studied. Complexes of different composition (Mo(VI) : Mo(V) = 5 : 1, 7 : 1, and 11 : 1) are formed in the Nb-Mo(VI)-Mo(V) system at niobium concentration of between 2×10^{-6} and 1×10^{-5} M. A photometric method was developed for determining niobium in heat-resistant alloys with the sensitivity of 0.01%. The mean error is 3%. (auth)

9806 SPECTROGRAPHIC DETERMINATION OF TUNGSTEN IN PURE METALS OF THE TITANIUM SUBGROUP, NIOBIUM, AND TANTALUM. Turulina, O. P.; Zakhariya, N. F. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 18: No. 9, 1754-1758(Sep 1973). (In Russian).

A method has been developed for spectrographic determination of tungsten in pure metals of the titanium subgroup, niobium and tantalum with the sensitivity of $(1-5) \cdot 10^{-4}$%. (auth)

9807 OXYGEN ANALYSIS OF SODIUM BY EQUILIBRATION WITH VANADIUM: AN ASSESSMENT. Hooper, A. J.; Trevillion, E. A. (Berkeley Nuclear Labs., Eng.). J. Nucl. Mater.; 48: No. 3, 216-222(Oct 1973).

An assessment of the V wire equilibration technique for the analysis of O in Na was made. The method is based on the principle that dissolved O will distribute between Na and V to give the same O activity in each metal at equilibrium. A theoretical analysis of O activities in Na and in V was used to derive the distribution coefficient, and it is shown that in theory the technique is applicable over a considerably narrower range of concentrations of O in Na than previously reported (up to only 1.9 ppM at 750°C). It is further shown that the attainment of equilibrium may be affected by the formation of compounds on the V surface. O activities may not be determined from the technique as described in the literature owing to its nonequilibrium nature. (auth)

9808 TELLURIUM IN ROCKS. Beaty, R. D.; Manuel, O. K. (Univ. of Missouri, Rolla). Chem. Geol.; 12: No. 2, 155-159(Oct 1973).

Twenty different rocks were analyzed for tellurium by atomic absorption. The average tellurium content of 12 igneous rocks is 82 ppB, with a range, 3.4 ppB ≥ Te = 210 ppB. In ultrabasic rocks, the tellurium content is ≤10 ppB. Of the rocks analyzed, carbonates showed the highest Te content, 1 to 2 ppM, and the tellurium concentrations in 6 sedimentary rocks decrease in the following order: carbonates > shales > sandstones. (auth)

9809 KINETIC DIFFERENCE METHOD BASED ON THE LANDOLT-TYPE REACTIONS. Weisz, H.; Rothmaier, K. (Univ., Freiburg i B.). Anal. Chim. Acta; 68: 93-102(1974). (In German).

A kinetic difference method based on Landolt-type reactions is described. The reaction is allowed to proceed simultaneously in two mixtures, one of which contains a known constant amount of the catalyst and the other the unknown amount. The catalyst can be determined by means of the difference between the two Landolt effects. The system hydrogen peroxide-iodide-ascorbic acid was used to determine molybdenum in the range 1-20 μg. Iodide was determined by its effect on the iodate-arsenite reaction in the range 1-30 μg. In both cases, the reactions were followed photometrically. Vanadium (0.1-3.0 μg) was determined by means of the bromate-iodide-ascorbic acid system, and copper (0.1-2 μg) by the peroxydisulphate-iodide-thiosulphate system, both reactions being followed potentiometrically. (auth)

9810 PROBLEM OF BAND DISPLACEMENT IN THE IR SPECTRA OF DIALKYLTHIOCARBAMATES. Part II. Diethyl- and Tetramethylenedithiocarbamates. The Range 500 to 32 cm^{-1}. Kellner, R. (Technische Hochschule, Vienna). Anal. Chim. Acta; 68: 49-60(1974). (In German).

The far infrared spectra of the diethyl- and tetramethylenedithiocarbamates (DEDTC and TMDTC) of Mn^{3+}, Fe^{3+}, Co^{3+}, Ni^{2+}, Cu^{2+}, Zn^{2+}, MoO_3^{2+}, Cd^{2+}, Hg^{2+} and Pb^{2+} in the region of 500-32 cm^{-1} are described. The evaluation of both position and absorbance of the bands in the far ir enables a classification of the metal chelates as planar, tetrahedral and octahedral coordinated compounds. Moreover, the region below 400 cm^{-1} can be used as a real "fingerprint" region and can serve to bypass several coincidences in the higher frequency part of the ir spectra of metal chelates. This is of general importance for the ir-spectrometric analysis of solid substances with similar structure. (auth)

9811 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM WITH CHROMEAZUROL S AND CETYLTRIMETHYLAMMONIUM BROMIDE. Evtimova, B. (Univ., Sofia). Anal. Chim. Acta; 68: 222-225(1974).

In studies of the highly sensitive reactions between some polyvalent metal ions, chromeazurol S and cetyltrimethylammonium bromide, it was found that thorium also forms a pure blue complex in aqueous solution. An investigation of the properties of this ternary, water-soluble thorium complex is being made because of its very high molar absorptivity (over 10^5). Since very sensitive reactions are important in trace analysis, a new possibility to determine thorium spectrophotometrically in a normal aqueous solution is suggested. (auth)

9812 INSTRUMENTATION FOR THE AUTOMATIC DETERMINATION OF CARBON IN URANIUM AND PLUTONIUM

CARBIDES. Bartscher, W.; Pel, D. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Anal. Chim. Acta; 68: 197-202(1974). (In German).

Instrumentation, consisting largely of commercial components, is described for the automatic determination of carbon in uranium and plutonium carbides. For the determination, the sample is burned in oxygen and the change in electric conductivity of a sodium hydroxide solution during the absorption of the formed carbon dioxide is measured. Voltage values corresponding to the initial and final conductivity, the weights and the sample identification are stored on paper tape for final computer evaluation. The standard deviation of the method is 10 μg of carbon, and the maximum capacity is 10 mg of carbon. The time demand for one determination is 11 min. (auth)

9813 NEW METHOD FOR AUTOMATIC DETERMINATION OF OXIDIZING OR REDUCING MATERIALS BY DIFFERENTIAL POTENTIOMETRY. Part II. Improvement of the Manual Determination of Lactose. Bosset, J. O. (Station Federale de Recherches Laitieres, Bern); Blanc, B.; Plattner, E. Anal. Chim. Acta; 68: 161-175(1974). (In French).

A new cerimetric method is proposed for the determination of lactose in whole fresh milk. Under well-defined and reproducible reaction conditions, the Ce(IV)/Ce(III) concentration ratio is considered at two given instants of the same redox reaction. In a given concentration range, the difference in the corresponding Nernst potential is proportional (plus a fixed constant) to the logarithm of the lactose concentration. The various parameters characterizing the reaction (temperature, time, pH, concentration ratio) are systematically studied in order to establish optimal conditions. The experimental results obtained confirm the general theoretical model proposed earlier for measurement of substances by differential potentiometry. After dialysis in continuous flow, the method is directly applicable to automatic continuous flow analysis. (auth)

9814 SPECTROPHOTOMETRIC STUDY OF THE REACTION OF MOLYBDENUM(VI) WITH 4-GALLOYLPYROGALLOL. Popa, G.; Dumitrescu, V.; Dumitrescu, N.; Gaivoronschi, B. Rev. Chim. (Bucharest); 24: No. 8, 635-638(Aug 1973). (In Rumanian).

A spectrophotometric stydy was made of the reaction of Mo(VI) with 4-galloylpyrogallol (2,3,4,-3; 3; 4'5'-hexahydroxy benzophenone) in aqueous solution. The reactant forms with Mo(VI) a yellow complex in acid medium (pH = 3.75 – 6.15). At an optimum pH of 5.42 and a wave length of 420 nm, Mo(VI) can be determined between the concentration limits of 1-20 $\mu g/cm^3$. The molar extinction coefficient is 14384. The instability constant obtained by the method of the Job non-isomolar series is 2.42×10, and the combination ratio molybdenum/reactant is 1/2. (auth)

9815 MASS SPECTROMETRY OF URANIUM HEXAFLUORIDE. Sato, H.; Asakura, Y.; Suzuki, S.; Sawai, H. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). Nippon Genshiryoku Gakkaishi; 14: No. 9, 473-477(Sep 1972). (In Japanese).

A mass spectrometric method for measuring the isotope ratio of uranium was required for the purpose of evaluating the results of experiments on uranium hexafluoride in a project related to centrifugal separation. Results obtained in determining the various conditions governing the mass spectrometry of UF_6 are given. The UF_5^+ ion was adopted for the uranium isotope ratio measurement. Further experiments are undertaken to determine the most favorable conditions for measuring the uranium isotope ratio in respect to sample gas, pressure in ion source, volume of electron beam, and electron potential. The optimum conditions determined were: specimen gas pressure in the ion source: 10^{-7} Torr, electron beam: 0.3 to 0.5 mA, electron potential: 70 to 90 eV, accelerating voltage: 4.0 to 4.5 kV. As an example of the accuracy attainable under such conditions, a $^{235}U/(1-^{235}U)$ value of $(0.7200 \pm 0.0005) \times 10^{-2}$ was obtained. (auth)

9816 DETERMINATION OF THE O/U RATIO OF NONSTOICHIOMETRIC URANIUM DIOXIDE BY MEANS OF SPECTROPHOTOMETRY. Kuhn, E. (Kernforschungszentrum, Karlsruhe, Ger.); Baumgaertel, G.; Schmieder, H.; Goergenyi, T. Z. Anal. Chem.; 267: No. 2, 103-105(1973). (In German).

From meeting of the Gesellschaft Deutscher Chemiker on trace analysis; Erlangen, Ger. (2 Apr 1973).

After dissolution of the sample in hot concentrated phosphoric acid, the concentrations of U^{4+} and U^{6+} are measured via the absorbance of two specific wavelengths. The method is simple and requires little time. It has been tested for O/U ratios 2.05 to 2.67. The reproducibility, related to the O/U ratio, is ± 0.005. (GE)

9817 ION ASSOCIATES OF SCANDIUM, YTTRIUM, AND LANTHANUM WITH METHYLTHYMOL BLUE AND DIPHENYLGUANIDINE. Beschetnova, E. T.; Golovina, A. P.; Zorov, N. B. (Daghestan State Univ., Makhachkala, USSR). Zh. Anal. Khim.; 28: No. 10, 1943-1946(Oct 1973).

The formation of extracted ion associates of scandium, yttrium, and lanthanum with methylthymol blue (MTB) and diphenylguanidine (DPG) has been established. Optimal conditions have been found for their formation and extraction. Molar extinction coefficients are $2.45 \cdot 10^4$ for the scandium compound, $3.7 \cdot 10^4$ for yttrium one, and $4.45 \cdot 10^4$ for lanthanum one. The molar ratios are Me: MTB: DPG = 1 : 2 : 2 for scandium and 1 : 1 : 2 for yttrium and lanthanum. An extraction-photometric method has been worked out for determining the elements in solutions of their salts. A deviation of the results obtained from those of the gravimetric analysis is not more than ±1.6%. (auth)

9818 PHOTOCHEMICAL REACTIONS IN ANALYTICAL CHEMISTRY. XV. Photochemical Oxidation of Cerium(III) to Cerium(IV). Nemodruk, A. A.; Bezrogova, E. V.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 10, 1947-1953(Oct 1973). (In Russian).

The photochemical oxidation of cerium(III) to cerium(IV) in carbonate solutions has been studied. The oxidation proceeds fastly in K_2CO_3 solution, a bit slower in Na_2CO_3, very slowly in $KHCO_3$ and $NaHCO_3$, and does not proceed at all in $(NH_4)_2CO_3$. The photochemical oxidation rate increases with increasing K_2CO_3 concentration in the solution to be irradiated. The irradiation duration, necessary for the complete cerium(III) oxidation is proportional to its initial concentration. The mechanism of the autooxidation and photochemical oxidation of cerium(III) to cerium(IV) has been studied; in both cases dissolved oxygen is the oxidizing agent which molecule intrudes into a carbonate complex of cerium; then the latter turns into a peroxide complex of cerium(IV). The uv-irradiation accelerates the process, in particular that of decomposition of hydrogen peroxide formed. The photochemical oxidation of cerium(III) to cerium(IV) in K_2CO_3 solution can be used for separation of cerium microamounts from other rare earths by coprecipitation with lanthanum hydroxide. (auth)

9819 LUMINESCENCE DETERMINATION OF EUROPIUM BY USING MIXED COMPLEX FORMATION WITH THENOYLTRIFLUOROACETONE AND HYDROXYETHYLETHYLENEDIAMINETRIACETIC ACID. Tishchenko, M. A.; Zheltvai, I. I.; Bakshun, I. V.; Poluzktov, N. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 10, 1954-1957 (Oct 1973). (In Russian).

Optimal conditions have been studied for luminescence determination of europium by its reaction with thenoyltrifluoroacetone (TTA) and hydroxyethylethylenediaminetriacetic acid (HEEDTA). A ratio of Eu: TTA: HEEDTA = 1 : 1 : 1 has been found for the complex formed. The method sensitivity is $3 \cdot 10^{-4}$% Eu_2O_3. The coefficient of variation is 0.79 to 2.31. (auth)

9820 SPECTROPHOTOMETRIC DETERMINATION OF ERBIUM IN A MIXTURE WITH LANTHANUM BY MEANS OF METHYLTHYMOL BLUE AND CETYLTRIMETHYLAMMONIUM BROMIDE. Poluzktov, N. S.; Ovchar, L. A.; Lauer, R. S. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 10, 1958-1961(Oct 1973). (In Russian).

The formation of ternary complexes in the interaction of rare earth ions with methylthymol blue in the presence of cetyltrimethylammonium bromide has been studied spectrophotometrically. A pH range of the existence of the complexes and a component ratio have been determined. A method has been developed for determining Er_2O_3 in $Er_2O_3 + La_2O_3$. The method is based on higher stability of yttrium group in comparison with lanthanum ones. The sensitivity is 1 to 2%. The coefficient of variation is 2 to 16%. (auth)

9821 POTENTIOMETRIC AND AMPEROMETRIC TITRATION OF SELENIUM AND TELLURIUM BY USING ASCORBIC ACID. Ivanova, Z. I.; Ignatenko, E. G.; Tarasova, V. A. (Rostov State Univ., USSR). Zh. Anal. Khim.; 28: No. 10, 1980-1984(Oct 1973). (In Russian).

Complex iodide tellurium ions and I_2 are reduced on a platinum electrode in the presence of KI at pH of about 1 accompanied by limit currents in a potential region of between +0,230 and –0,0100 V for tellurium ions and between +0.280 and –0,250 V for I_2 (with respect to saturated calomel electrode). A change in the concentration of the complex tellurium ions and iodine leads to a marked change in the platinum electrode potential only at $i \geq 1$ μA. A potentiometric method and an amperometric method have been worked out for the titration of Se (IV) and Te (IV) with ascorbic acid in the presence of each other. (auth)

9822 DETERMINATION OF RUTHENIUM BY A KINETIC METHOD BY THE REACTION OF OXIDIZING P-QUINONE WITH MANGANESE(III) PYROPHOSPHATE. Mueller, H.; Tikhonova,

L. P.; Yatsimirskii, K. B.; Borkovets, S. N. (Univ., Leipzig). Zh. Anal. Khim.; 28: No. 10, 2012-2016(Oct 1973). (In Russian).

A kinetic method has been developed for determining ruthenium by the reaction of oxidizing p-quinone with manganese (III) pyrophosphate. The method enables determination down to 0.05 μg/ml Ru (in 10 ml of the solution) in the analysis of its chloride compounds and down to 0.01 μg/ml Ru (in 10 ml) in the analysis of its sulfate compounds. The error is not more than 17%. Gold, platinum, rhodium, and iridium compounds as well as sulfate palladium ones do not interfere. Chloride palladium compounds catalyze the reaction. (auth)

9823 KINETICS OF GAS-METAL INTERACTION APPLIED TO DETERMINATION OF GASES IN METALS BY THE METHODS OF VACUUM FUSING AND ISOTOPE DILUTION. III. Kinetics of the Isotope Equilibrium Attainment in the Determination of Nitrogen in Metals by the Isotope Dilution Method. Vitol, E. N.; Orlova, K. B. (Central Scientific-Research Inst. of Metallurgy and Welding, Leningrad). Zh. Anal. Khim.; 28: No. 10, 2017-2024 (Oct 1973). (In Russian).

Isotope equilibrium attainment time is often very high in a heterogeneous system of nitrogen-melt. This can lead to some complications linked with the effect of adsorption-active sublimates. Methods are recommended which make it possible in the beginning of the analysis to localize the isotope indicator and a gas analyzed in the liquid phase where exchange reactions proceed with high rates. (auth)

9824 USE OF SOME DYES FOR DETERMINATION OF IODIDES BY A KINETIC METHOD. Yasinskene, E. I.; Umbrazhyunaite, O. P. (Vilnyus State Univ., USSR). Zh. Anal. Khim.; 28: No. 10, 2025-2028(Oct 1973). (In Russian).

Oxidation reactions of some dyes of the triphenylmethane series and azo dyes with hydrogen peroxide in an acidic medium catalyzed with iodides were studied. The most sensitive oxidation reactions in the presence of iodides have been observed for catechol violet ($2 \cdot 10^{-3}$ μg/ml I), bromopyrogallol red ($1.09 \cdot 10^{-2}$ μg/ml I), stilbazo ($5.45 \cdot 10^{-2}$ μg/ml I), and pyrogallol red ($1 \cdot 1$ μg/ml I). In the presence of 0.2 g-ion/l Cl^- the sensitivity of the determination of iodides increases by about 2 times, and 1000-fold amounts of bromides do not interfere. (auth)

9825 DETERMINATION OF Mo(VI) BY THE METHOD OF INVERSION VOLTAMMETRY ON A GRAPHITE ELECTRODE. Pnev, V. V.; Popov, G. N.; Nagarev, V. G. (Tyumen Industrial Inst., USSR). Zh. Anal. Khim.; 28: No. 10, 2050-2052(Oct 1973). (In Russian).

A possibility has been shown of using the method of inversion voltammetry on a graphite electrode for analytical determination of 10^{-5}–10^{-3} g-ion/l Mo. (auth)

9826 ATOMIC ABSORPTION DETERMINATION OF SELENIUM AND TELLURIUM IN PURE GOLD. Balandina, N. S.; Yudelevich, I. G.; Khrapai, V. P.; Abakumov, D. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Zh. Anal. Khim.; 28: No. 10, 2054-2056(Oct 1973). (In Russian).

The effect of HCl, HNO_3, Au, and impurities of Pt, Pd, In, Cu, Sn, Zn, Pb, Fe, Bi, Sb on the atomic absorption of selenium and tellurium and their mutual effect in the propane–butane–air flame have been studied. An atomic-absorption method is suggested for determination of selenium and tellurium in pure gold at their concentration of more than $5 \cdot 10^{-5}$ and $5 \cdot 10^{-6}$% respectively. The coefficient of variation is 1 to 10%. The main macrocomponent is extracted by di-n-butylsulfide for concentrating selenium and tellurium. (auth)

9827 HIGHLY SELECTIVE SPECTROPHOTOMETRIC DETERMINATION OF BERYLLIUM BY 8-HYDROXYQUINALDINE. Keil, R. (Inst. fuer Reaktorforschung, Wuerenlinger, Switzerland). MIAGA: No. 6, 919-923(1973). (In German).

The selectivity of the spectrophotometric determination of beryllium by 8-hydroxyquinaldine has been essentially increased by removal of interfering cations with ammonium pyrrolidinedithiocarbaminate. The determination of beryllium in the presence of about 60 cations and 20 anions has been investigated. The separation is also suitable for other methods of beryllium determinations. (auth)

9828 REDUCTION OF IODATE BY HYDRAZINE: APPLICATION OF THE IODIDE ION SELECTIVE ELECTRODE TO THE UNCATALYZED REACTION. Hasty, R. A. (Montana State Univ., Bozeman). Mikrochim. Acta; No. 6, 925-933(1973).

The reduction of iodate by hydrazine was examined by use of the iodide ion selective electrode. The rate of reduction of iodate at iodide concentrations below 5×10^{-5} *M* is controlled by the direct reduction by hydrazine. At higher iodide concentrations, the rate of reduction of iodate is controlled by the reduction of iodate by iodide with the subsequent reduction of iodine by hydrazine. Application of the reaction to the determination of μg quantities of iodine is discussed. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 10124, 10178, 10211, 10228, 10231, 10251, 10256, 10278, and 10334.

9829 (CONF-720920-, pp Paper 2, 1-18) CHARGED PARTICLE INDUCED X-RAY ANALYSIS: A NEW TOOL IN FORENSIC SCIENCE. Barnes, B. K.; Beghian, L. E.; Kegel, G. H. R.; Mathur, S. C.; Quinn, P. (Lowell Technological Inst., MA). 1972.

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

The technique of charged particle induced x-ray analysis of trace elements for forensic science shows promise of being as useful a tool as neutron activation analysis or emission spectroscopy have proven to be. Considerable development work remains to be done to put the technique on an equal footing with other well-developed analysis techniques, but when fully developed the technique should allow a wide range of elements to be analyzed rapidly at low concentrations. (auth)

9830 (RISO-M-1610) RADIOISOTOPE-EXCITED X-RAY FLUORESCENCE ANALYSIS AND ITS APPLICATION TO GEOCHEMICAL EXPLORATION IN GREENLAND. Kunzendorf, H. (Danish Atomic Energy Commission, Risoe. Research Establishment). May 1973. 133p. (In German). Dep. NTIS (U. S. Sales Only) $8.75.

The principles of x-ray fluorescence are briefly described. In particular, two methods of radioisotope x-ray fluorescence analysis are discussed: (a) radioisotope x-ray fluorescence analysis by means of portable apparatus incorporating scintillation or proportional counters and balanced differential x-ray filters, and (b) radioisotope x-ray fluorescence spectrometry by means of Si(Li) or Ge(Li) semiconductor detectors. For a portable radioisotope x-ray fluorescence analyzer calibration curves were established for Cr, Ni, Cu, Zn, Zr, Nb, Mo, La + Ce, and Pb in rock powders, Ti, Zr, and Nb in plane cut rock surfaces, and Zr, Nb, and La + Ce in rock outcrops. Detection limits found from calibration data were 0.3% Cr, 0.06% Ni, 0.14% Cu, 0.14% Zn, 0.04% Zr, 0.07% Nb, 0.03% Mo, 0.02% La + Ce, and 0.1% Pb in rock powders, 0.07% Ti, 0.4% Zr, and 0.1% Nb in cut rock surfaces, and 0.14% Zr, 0.15% Nb, and 0.16% La + Ce in rock outcrops. Values for the accuracy and the precision of these analyses are given. Special investigations include the dependence of the analytical result on the grain size of the sample material and experiments regarding the critical sample weight. Si(Li) and Ge(Li) x-ray spectrometers for the analysis of rock samples were described. Two methods of x-ray spectrum reduction carried out by means of a 32K computer were investigated: simple channel-by-channel integration and least-squares fitting. Calibration data on rock powders yielded for the Si(Li) x-ray spectrometer (1 mCi ^{109}Cd for excitation of characteristic x-rays) 23 ppm Rb, 110 ppm Sr, 69 ppm Zr, 206 ppm Nb, and 172 ppm Mo as detection limits for the analysis of rock powders. For plane cut rock surfaces and the Ge(Li) x-ray spectrometer (10 mCi ^{241}Am for excitation purpose) detection limits of 400 ppm Ce and 180 ppm Nb were obtained. The influence of interferences on the analytical result such as overlapping of x-ray peaks, absorption of x-rays in the sample and grain-size effects are dealt with. Special emphasis is given to the correction of x-ray intensities by means of scattered x-radiation. Portable radioisotope x-ray fluorescence analyzers were applied in geochemical investigations of Zr, Nb, and La + Ce in a series of alkaline rocks of the Ilímaussaq intrusion, South Greenland, of Mo in molybdenite-bearing rocks, and of Zr and La + Ce in sedimentary rocks from East Greenland. Semiconductor x-ray spectrometers were used in the analysis of sediments from a stream draining the Ilímaussaq intrusion, South Greenland, in the analysis of La, Ce, Ni, Cu, and Zn in stream sediments from East Greenland, and in investigations of Rb, Sr, Zr, Nb, Sn, Ba, La, Ce, Pr, and Nd in cut drill cores. (auth)

9831 (TRITA-KKE-7302, pp 35-43) ANALYSIS OF LEAD BY X-RAY FLUORESCENCE WITH A 88 keV ^{109}Cd RADIATION SOURCE AND Ge(Li) DETECTOR. Feb 1973. (In Swedish).

A method of quantitative nondestructive analysis of very small amounts of lead has been developed. The method is based on x-ray fluorescence. The γ-line from ^{109}Cd is used as radiation source. A Ge(Li)-detector was used for registration of the x-ray lines of lead. The accuracy and applications of the method are discussed. (SW)

9832 METHOD FOR THE DETERMINATION OF INDEPENDENT YIELDS IN FISSION WITH A Ge(Li) DETECTOR. Parsons, R. W.; Sharma, H. D. (Univ. of Waterloo, Ont.). Radiochem. Radioanal. Lett.; 15: No. 4-5, 335-345(20 Nov 1973).

A method for the determination of independent yields in fission is outlined. A high-resolution Ge(Li) detector is used for recording γ spectra of chemically separated elements from fission-product mixtures. The independent yields are evaluated such that γ-ray intensity data of nuclides, the efficiency of the detector and geometry factors, etc. are not needed. (auth)

9833 DETECTION SENSITIVITY OF HEAVY IMPURITIES IN Si USING 280-keV He^{2+} AND C^{2+} BACKSCATTERING. Hart, R. R.; Dunlap, H. L.; Mohr, A. J.; Marsh, O. J. (Hughes Research Labs., Malibu, CA). Thin Solid Films; 19: No. 1, 137-144(3 Dec 1973).

Background limitations, especially those involving pulse pile-up, on the sensitivity to detection of heavy elements near the surface of Si were investigated with back-scattered 280 keV He^{2+} and C^{2+}. Using gated electronics, pulse pile-up was reduced by as much as a factor of 1/60, which permitted a detection sensitivity, i.e., equal signal and background, of approximately 2×10^{11} Tl atoms/cm^2 for He^{2+} back-scattering, while C^{2+} back-scattering data showed a detection sensitivity of about 2×10^{10} Tl atoms/cm^2. Back-scattering from Si implanted with 20 keV Tl^+ to doses of 1×10^{13} and 1×10^{12} ions/cm^2 was used for experimental confirmation of the He^{2+} and C^{2+} back-scattering sensitivities. (auth)

9834 PROTON-INDUCED X-RAY CROSS SECTIONS FOR SELECTED ELEMENTS Fe TO As AND APPLICATIONS OF X-RAY ANALYSIS TO SEMICONDUCTOR SYSTEMS. Gray, T. J. (North Texas State Univ., Denton); Lear, R.; Dexter, R. J.; Schwettmann, F. N.; Wiemer, K. C. Thin Solid Films; 19: No. 1, 103-119(3 Dec 1973).

Ionization cross sections and K shell X-ray production cross sections for the elements Fe, Co, Cu, Zn, Ga, Ge and As were measured for incident proton energies from 500 to 2000 keV. A 2 MV Van de Graaff was used to provide the protons and the X-ray energy spectra were measured with a high resolution Si(Li) detector. All measurements were made on thin targets ($\rho x \sim 10-30$ μg/cm^2) as determined by elastic proton scattering. Comparisons with the plane wave Born approximation and the binary encounter approximation theoretical models are made. Applications to Zn-implanted GaAsP have shown that, during an 850°C anneal process, a fraction of the implanted Zn is lost by out-diffusion through a deposited SiO_2 overcoat. Sensitivities for Zn in GaAsP are discussed. Profiling of As implanted in silicon by detecting the As Kα X-rays has shown a lower sensitivity limit of 2×10^{11} As/cm^2 under the beam with the limiting factor attributed to the proton-induced bremsstrahlung from the silicon substrate. Measurements of Ni–chrome films have been made to determine alloy composition for different deposition conditions and sputtering threshold effects are observed for NiCr systems. (22 references) (auth)

9835 ASSESSMENT OF ION-INDUCED X-RAYS FOR ANALYSIS. Cairns, J. A. (Atomic Energy Research Establishment, Harwell, Eng.); Marwick, A. D.; Mitchell, I. V. Thin Solid Films; 19: No. 1, 91-102(3 Dec 1973).

The use of ion-induced x-rays for elemental analysis of solids is considered. The current state of the theory for both protons and heavy ion projectiles is discussed. In particular, the use of correlation diagrams is described, and examples are given to illustrate consequent applications. Selected practical applications are presented in some detail to elucidate the advantages of the technique and also to point out some potential complications. (42 references) (auth)

9836 COMBINED USE OF He BACKSCATTERING AND He-INDUCED X RAYS IN STUDY OF ANODICALLY GROWN OXIDE FILMS ON GaAs. Feldman, L. C.; Poate, J. M.; Ermanis, F.; Schwartz, B. (Bell Telephone Labs., Inc., Murray Hill, NJ). Thin Solid Films; 19: No. 1, 81-89(3 Dec 1973).

Anodic oxide films on GaAs were studied by the combined use of He back-scattering and He-induced x-rays. Back-scattering is hampered by the lack of mass resolution between Ga and As. X-ray analysis has excellent mass resolution but poor depth resolution. This poor depth resolution is overcome by increasing the effective thickness of the films by entering at grazing angles and making use of the property that the He-induced x-ray cross sections fall steeply with decreasing energy. This technique and the methods of data analysis are discussed in detail. The anodic oxide films are found to be deficient in As within 200 Å of the surface and to have a Ga : As ratio of approximately 1 : 1 for the rest of the oxide. On heating to 650°C most of the As diffuses out of the films. (auth)

9837 SURFACE ANALYSIS USING PROTON BEAMS. Musket, R. G.; Bauer, W. (Univ. of California, Livermore). Thin Solid Films; 19: No. 1, 69-80(3 Dec 1973).

Characteristic x-rays, back-scattered protons and Auger electrons are emitted from the surface region of solids under bombardment by protons. Energy analysis of these emitted particles yields data which permit identification of the atoms present in the surface region; in addition, quantitative surface composition information has been obtained using appropriate calibrations. Results from analyses using the techniques of (1) proton-induced x-rays (PIX), (2) Rutherford back-scattering (RBS) and (3) Auger electron spectroscopy (AES) for bombardments by mono-energetic 100 to 400 keV protons are collated and discussed. These previously published results are reviewed to illustrate the types of compositional information obtainable and the advantages and disadvantages of each of the techniques with regard to elemental sensitivities, depth resolutions, reaction cross sections and complex targets. Finally, the complementary nature of the three techniques is discussed with emphasis on the possibilities for simultaneous analyses. (29 references) (auth)

9838 ANALYSIS OF SURFACE LAYERS BY LIGHT-ION BACKSCATTERING AND SPUTTERING COMBINED WITH AUGER ELECTRON SPECTROSCOPY (AES). Behrisch, R.; Scherzer, B. M. U.; Staib, P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Thin Solid Films; 19: No. 1, 57-67(3 Dec 1973).

Two major methods for determining thickness and composition of thin layers are the back-scattering of protons and helium ions in the energy range 0.060–2.5 MeV, and sputtering combined with AES. Both methods were applied to identical metal sandwich targets of Be, Cu, and Nb. The results show that the methods supplement each other remarkably. The nondestructive back-scattering technique gives quantitative thickness measurements of the high mass components (Nb, Cu) with an accuracy to about 10% of the total thickness. The depth resolution is between 100 and 200 Å near the surface. Its increase with depth depends on the energy of the primary ions, e.g., it increases by a factor of two roughly every 4000 Å in the case of 2 MeV He^+ in Al. The destructive sputtering and AES technique has the advantage that the depth distribution of nearly all components (i.e., including impurities like C and O) can be determined with high depth resolution, especially in surface layers. If the excitation cross section and escape depth of the Auger electrons are taken into account, relative concentrations can be estimated. Non-uniform sputtering may cause serious errors. For absolute thickness measurements the method can be calibrated by the back-scattering method. Sputtering yields measured on Cu and oxygen-contaminated Nb are in rough agreement with the values in the literature. The depth resolution of sputtering combined with AES is approximately 50 Å near the surface and its increase with depth depends strongly on the target composition. (22 references) (auth)

9839 ION PROBE MASS SPECTROMETRY: OVERVIEW. Evans, C. A. Jr. (Univ. of Illinois, Urbana). Thin Solid Films; 19: No. 1, 11-19(3 Dec 1973).

The bombardment of a surface by 1 to 25 keV primary ions causes the upper atomic layers to be "sputtered" or stripped off. Most of the material leaves as neutral atoms or molecules, but a small fraction is ejected as positive or negative ions. These secondary ions can then be characterized by a mass spectrometer to provide an analysis of that portion of the material sampled by the primary ion beam. At any one instant, the excitation volume is bounded by the primary ion beam periphery (1–300 μm) and extends to a depth of 5–50 Å depending on experimental conditions. By mass spectrometrically monitoring one or several masses, the analyst can obtain isotopic and concentration in-depth profiles of the sample constituents. Alternatively he can obtain a complete mass spectrum as the primary beam erodes the sample. Control and localization of the primary ion beam erosion permit chemical analyses with lateral x, y resolutions of approximately 1 μm, the examination of fractional surface monolayers, an in-depth analysis with better than 100 Å resolution, and the acquisition of secondary ion images. The mass spectrometer provides elemental coverage from hydrogen to uranium, isotopic characterization and detection limits of 10^{-15} to 10^{-19} g, depending on the element under consideration. The production of secondary ions, the various types of instrumentation used, and applications of the ion probe technique are discussed. (21 references) (auth)

9840 COMPARISON OF BACKSCATTERING PARAMETERS USING HIGH-ENERGY OXYGEN AND HELIUM IONS. Petersson, S. (Inst. of Tech., Uppsala); Tove, P. A.; Meyer, O.; Sundqvist, B.; Johansson, A. Thin Solid Films; 19: No. 1, 157-164(3 Dec 1973).

For material analysis by ion back-scattering spectrometry the quality of information obtainable depends on the mass of the back-scattered ions used. Relevant parameters affecting analysis are the mass resolution, depth resolution, depth range of the ion and time of analysis. These parameters are compared here for two types of analyzing ions, α-particles and ^{16}O ions, at optimum values of ion energy. Under the energy conditions chosen, ^{16}O

ions gave a better mass resolution by a factor of about 2 to 4 (depending on the mass range) and a better depth resolution by a factor of between 1.5 and 2. (auth)

9841 POSSIBLE USE OF A ^{119m}Sn SOURCE FOR X-RADIOMETRIC ANALYSIS OF MOLYBDENUM ORES. Ochkur, A. P.; Leman, E. P.; Kotel'nikov, V. V.; Ivanov, V. M.; Yanchevskii, Yu. P. At. Energ. (USSR); 35: No. 3, 204-205(Sep 1973). (In Russian).

A special ^{119m}Sn source, x in a cylindrical Al tube, 5 mm dia by 3 mm high, and having an activity of 1 to 20 mCi, was constructed for use in Mo determination. Use of the source for Mo determination in a series of model ores, using a wide solid angle with no collimation of the apparatus and with a xenon proportional counter as detector, showed a sensitivity to 0.005% Mo, compared to 0.02% with a ^{109}Cd source. An advantage of the ^{119m}Sn source is that with it, Cu and W can be determined simultaneously. (TTT)

9842 RADIOMETRIC METHODS FOR DETERMINATION OF VANADIUM IN THE PRESENCE OF CHROMIUM. Savkin, M. E.; Nguen Dyk Ngia; Shamaev, V. I. (Moscow Chemical-Technological Inst.). Zh. Anal. Khim.; 18: No. 9, 1732-1735(Sep 1973). (In Russian).

A possibility has been shown of determining vanadium in the presence of chromium by a radiometric method with substoichiometric separation. A procedure was developed for the analysis of a binary system vanadium–chromium with the use of calibration curves. (auth)

9843 ION SCATTERING SPECTROMETRY BELOW 10 keV. Honig, R. E.; Harrington, W. L. (RCA Labs., Princeton, NJ). Thin Solid Films; 19: No. 1, 43-56(3 Dec 1973).

Elastic binary collisions of keV rare gas ions with surface atoms provide energy spectra characteristic of the masses of the scattering centers. This information can be used to determine the composition of the outermost atomic layer of a solid, regardless of its conductivity. Since the primary ion beam removes at the same time the outer layers of the sample by sputtering, concentration profiles of major and minor constituents are readily obtained down to a depth of several thousand Å. In the case of insulators, positive charge-up is avoided by flooding the sample with electrons. The size of a given scattered peak depends on a number of parameters, including the scattering cross section, a neutralization factor, and geometrical considerations. Thus, elemental sensitivities are not readily predictable, but quantitative analyses are nevertheless possible with the help of calibration samples. Except for lattice geometry, matrix effects such as the enhancement of elemental sensitivities by oxygen encountered in secondary ion mass spectrometry, do not present a problem. In the instruments presently in use, the detected scattered signal comes from an area several hundred μm wide and several mm long; thus the data obtained represent an average, rather than a localized, composition. However, when appropriate experimental conditions are employed, only about one monolayer will be consumed during an analysis, thus making this a true "surface" method. Results are given for different types of problems resolved by this technique, and an up-to-date bibliography presented. (62 references) (auth)

9844 MICROTHIN-LAYER CHROMATOGRAPHY OF TRITIUM-BEARING SUBSTANCES BY LUMOAUTORADIOGRAPHIC DETECTION. Belen'kii, B. G.; Solodovnikova, E. G. (Inst. of High-Molecular Compounds, Leningrad). Zh. Anal. Khim.; 18: No. 9, 1772-1776(Sep 1973). (In Russian).

A method has been developed for determination of tritium in tritium-bearing substances based on microthin-layer chromatography and lumoautoradiographic detection with the sensitivity of 10^{-9} Ci in a spot. If a standard is used, the method permits the quantitative estimation of tritium concentration with the error of several per cent. The error makes up 10–15% in the absence of the standard. (auth)

9845 FISSION CESIUM SEPARATION FROM IRRADIATED NUCLEAR FUEL THROUGH ION EXCHANGE WITH AMMONIUM-12-MOLYBDATO-PHOSPHATE. Baraniak, L.; Hermann, A. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 9: No. 9, 312-317(Sep 1973). (In German).

The described analyzing method is based on simple fast and quantitative ^{137}Cs separation from nitric acid solutions of uranium fission products, performed after short-time decay through ion exchange with ammonium-12-molybdato-phosphate. The disturbance of high-purity fission cesium separation caused by the nuclides ^{95}Zr and ^{95}Nb is removed through the application of complexing agents. Both oxalic acid and tartaric acid used together with a mixture of H_2SO_4 and HF proved to be suitable for this end, depletion coefficient with regard to the fission products Zr and Nb being 4.5×10^4. Quantitative cesium separation is provided in one step with maximum radiochemical purity ranging 2%. Comparison of the described analyzing method with well-known extractive and classical analytic methods of cesium separation proved its superiority in many respects. (auth)

9846 APPARATUS AND METHOD OF CHARGE-PARTICLE SPECTROSCOPY FOR CHEMICAL ANALYSIS OF A SAMPLE. Watson, J. M. US Patent 3,766,381. 16 Oct 1973. Priority date 7 May 1971, United Kingdom of Great Britain and Northern Ireland. 8p.

An area of a sample is irradiated with electromagnetic radiation so as to release electrons from the area. The electrons are focused to form an image of the sample in an image plane. An apertured image plate is positioned in the image plane to permit only those electrons from a small region of the emitting area to pass. Electrons passing the aperture are energy analyzed. The result is the equivalent of using a microprobe to irradiate the small region. The particles may be retarded before they enter the analyzer, in order to increase sensitivity. A focusing system of five or more lens elements is shown for permitting the analyzer to be used with or without the lens plate without repositioning the system lenses. (Official Gazette)

9847 SELECTED AREA AND IN-DEPTH AUGER ANALYSIS OF THIN FILMS. Morabito, J. M. (Bell Telephone Labs., Inc., Allentown, PA). Thin Solid Films; 19: No. 1, 21-41(3 Dec 1973).

Auger electron spectroscopy (AES) has rapidly developed from a purely research oriented technique into an extremely versatile analytical method with unique features for qualitative and quantitative materials characterization. The low escape depth (5 to 10 Å) of the emitted Auger electrons makes it ideal for surface analysis and for depth profile impurity distribution analysis when combined with in situ ion sputtering. Both surface and depth profile analysis can be accomplished on a selected area by the use of optical or primary electron beam scanning techniques. Results are presented which illustrate the significance of the analytical capabilities of AES in the qualitative and quantitative analysis of thin film electronic materials used in the fabrication of precision thin film resistors, capacitors and conductors. (45 references) (auth)

9848 DETERMINATION OF Rb/Sr AND ^{87}Sr/^{86}Sr RATIOS OF SOME STANDARD ROCKS AND EVALUATION OF X-RAY FLUORESCENCE SPECTROMETRY IN Rb–Sr GEOCHEMISTRY. Pankhurst, R. J.; O'Nions, R. K. (Oxford Univ.). Chem. Geol.; 12: No. 2, 127-136(Oct 1973).

New isotope dilution results are presented for Rb and Sr concentrations in U.S.G.S. standard rocks and NBS-70a K-feldspar. The results (based on at least five analyses of each rock), are generally accurate to ±0.5% and resolve discrepancies in previously published data. X-ray fluorescence analyses of the same samples yield Rb and Sr determinations which are only accurate to ±5%, but Rb/Sr ratios which are as precise and in excellent agreement with the isotope dilution values. It is concluded that X.R.F. determination of Rb/Sr ratios is perfectly suitable for whole-rock Rb–Sr geochronology. ^{87}Sr/^{86}Sr ratios were determined on G-2, GSP-1, BCR-1, and AGV-1 as well as the Eimer and Amend $SrCO_3$ standard. (auth)

9849 PHOTON-EXCITED ENERGY-DISPERSIVE X-RAY FLUORESCENCE ANALYSIS FOR TRACE ELEMENTS. Goulding, F. S.; Jaklevic, J. M. (Lawrence Berkeley Lab., CA). Annu. Rev. Nucl. Sci.; 23: 45-74(1973).

The physical mechanisms of photon-induced fluorescence are discussed as to production of characteristic spectral lines, scattering processes, background-producing processes, and detection sensitivity. The design of analysis spectrometers is discussed as to the primary radiation source, electronic system, energy resolution, and counting-rate performance. Other section titles include: calibration, experimental results, and comparison with particle excitation. (32 references) (JGB)

9850 DETERMINATION OF CESIUM IN GLASS BY THE ISOTOPE-DILUTION METHOD. Pomeranteva, A. V.; Zimakov, I. E.; Spitsyn, V. I. (Inst. of Physical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 10, 1894-1900(Oct 1973). (In Russian).

The effect of extraction time, pH of the equilibrium aqueous phase, and presence of Na^+, K^+, Ca^{2+}, Mg^{2+}, AlO_2^- on extraction-substoichiometric separation and determination of cesium has been studied. Optimal dilution conditions have been found for two modifications of the method of multiple isotope dilution with the use of a radioisotope without carrier. A procedure has been developed for the determination of cesium in silicate-aluminate glass and in a strontium-silicate-borate one by the method of isotope dilution with the use of substoichiometric separation in systems of 10^{-4} *M* magnesium dipicrylaminate or sodium tetraphenylborate solution–nitrobenzene. (auth)

9851 ANALYSIS OF TANTALUM–NIOBIUM COMPOUNDS BY RADIOMETRIC METHODS. Calibration Curves With the Use of Solvent Extraction of Inorganic Complexes. Shamaev, V. I.; Sav-

kin, M. E. (Moscow Chemical-Technological Inst.). Zh. Anal. Khim.; 28: No. 10, 2058-2061(Oct 1973). (In Russian).

The extraction of niobium and tantalum by methyl isobutyl ketone, 50% tributyl phosphate solution in chloroform and cyclohexanone has been studied. Methods have been developed for determining 0.2 to 25% of tantalum in niobium in HCl solutions and a method for the analysis of tantalum–niobium compounds in a H_2F_2 medium. (auth)

9852 RADIOCHEMICAL ANALYSIS OF ^{210}Pb, AS WELL AS DISTRIBUTION OF ^{210}Pb, ^{90}Sr, AND ^{137}Cs IN SOIL PROFILES. 1. Kodaira, K. (Sagami Chemical Research Center, Kanagawa, Japan); Kato, M.; Ishikawa, M. Radioisotopes (Tokyo); 22: No. 7, 331-337(Jul 1973).

Soils were extracted with 6 N hydrochloric acid containing Pb, Cs, and Sr carriers. ^{137}Cs and ^{90}Sr were separated, and then Pb in the residual solution was separated as sulfide and radiochemically purified. After the addition of Bi carrier and the achievement of radioactive equilibrium, Bi was separated as oxychloride and submitted to radioassay. This radioactivity was identified as that of ^{210}Bi. Therefore this method was considered as a useful one for radiochemical analysis of ^{210}Pb in soil. By the application of this method, the following results were obtained: ^{210}Pb was distributed mostly within soil profiles reaching down to 15 cm. The trend of vertical distribution was almost the same also for ^{90}Sr and ^{137}Cs. ^{210}Pb content was higher in phosphate rocks than in soils. But a hypothetical pathway, along which ^{210}Pb in phosphate rocks contaminates soils as an impurity of phosphate fertilizers, was not considered to make an important contribution to the ground deposition of ^{210}Pb. (auth)

9853 X-RAY FLUORESCENT DETERMINATION OF RARE EARTH ELEMENTS IN CARBON AND LOW-ALLOY STEEL. Matsumura, T.; Morooka, R.; Kotani, N.; Goto, T. (Kobe Steel, Ltd., Japan). Tetsu To Hagane; 59: No. 8, 1159-1165(Jul 1973). (In Japanese).

In a recent study to improve the properties of steel by the addition of rare earth elements, a need arose for an accurate analytical method of these elements. An investigation was undertaken to determine four rare earth elements (La, Ce, Nd, and Pr) in the range 0.005 to 0.15% by the x-ray fluorescent technique. In the absence of reliable standards, the glass-bead technique for odd samples such as drillings was developed. Rare earth elements were precipitated as the fluorides after dissolving 5 g of the sample in sulfuric acid, and the filtered fluorides followed by ignition to oxides were mixed with sodium tetraborate and melted to prepare glass-bead. The glass-bead method provided for precision less than 2% of the amount present. A good agreement was obtained between the chemical and x-ray results. The advantages of the method are the facility of the construction of a calibration curve by using chemical reagents, the absence of interelemental effects because of the separation of rare earth elements, and the versatility to be applicable to other materials with minor modifications. The standard samples of low-alloy steel were furthermore prepared for the direct metal disk technique and a conventional procedure was taken with satisfactory results. (auth)

Separation Procedures

Refer also to abstracts 11463 and 12471.

9854 (BMFT-FBK-73-22, pp 27-30) RAPID SEPARATION OF CERIUM FROM FISSION PRODUCTS OF URANIUM-235. Seyb, K. E. Aug 1973. (In German).
In annual report, 1972.

9855 (BMFT-FBK-73-22, pp 31-32) RAPID SEPARATION OF YTTRIUM FROM FISSION PRODUCT MIXTURES. Klein, G. Aug 1973. (In German).
In annual report, 1972.

9856 (BMFT-FBK-73-22, pp 32-37) RAPID RADIOCHEMICAL SEPARATION OF STRONTIUM AND BARIUM NUCLIDES FROM FISSION PRODUCT MIXTURES. Grimm, W.; Herzog, W. Aug 1973. (In German).
In annual report, 1972.

9857 (BMFT-FBK-73-22, pp 37-39) SOLVENT EXTRACTION OF MOLYBDENUM. Tittel, G. Aug 1973. (In German).
In annual report, 1972.

9858 (BMFT-FBK-73-22, pp 40-43) VOLATILIZATION OF FISSION PRODUCTS FROM SOLID FLUORIDE-CONTAINING TARGETS. Weber, M.; Menke, H.; Trautmann, N. Aug 1973. (In German).
In annual report, 1972.

9859 (DP-1336) DISTRIBUTION OF SELECTED LANTHANIDES AND ACTINIDES BETWEEN 30% TBP IN N-PARAFFIN AND VARIOUS METAL NITRATE SOLUTIONS. Thompson, M. C. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1973. Contract AT(07-2)-1. 28p. Dep. NTIS $4.00.

Distributions were measured for nitric acid, americium, curium, cerium, neodymium, samarium, europium, manganese, and mercury between 30 vol % TBP in n-paraffin and aqueous solutions containing nitric acid, aluminum nitrate, lithium nitrate, and/or sodium nitrate. Equations for the distributions were derived from the data and used in designing solvent extraction flowsheets for recovery and decontamination of americium and curium from irradiated plutonium–aluminum alloy. Also investigated was the effect of DTPA acid on the distribution of the actinides and lanthanides in the same systems. The actinides (Am and Cm) are more strongly complexed than the light lanthanides (La, Ce, Pr, and Nd) by DTPA acid. By controlling the solution pH in the range of 1 to 3, separation of actinides from lanthanides by factors of 10 to 100 may be obtained by extraction with 30% TBP. (auth)

9860 (INIS-mf-920) ION FOCUSING ELECTROPHORESIS. Application to the Separation of Rare Earth Elements. Pueschel, C. R. (Sao Paulo Univ. (Brazil). Instituto de Quimica). 1971. 60p. (In Portuguese). INIS.
Thesis.

A variation of the "Electrophoretic Focusing of Ions" technique is described. The method allows a separation of lutetium and ytterbium employing cathodic solutions containing copper ions and a mixture of complexing agents (EDTA and NTA). The method is similar to the ion-retention technique used in the separation of mixtures of rare earth elements with ion-exchange columns. Also included is a brief review of the process, giving special attention to application in the fields of radiochemistry and nuclear energy. The method is described theoretically and also in the practical sense. The experimental part is given in a logical sequence, starting with the systematization of experimental conditions using mixtures of lutetium and lanthanum as reference mixtures. The checking of the separation is performed with autoradiographies, gamma spectrometry, decay curves, and an enrichment factor defined in the text. (INIS)

9861 (RFP-Trans-145) EXTRACTION OF LANTHANIDES AND ACTINIDES BY MEANS OF DIBUTYLPHOSPHORIC ACID. II. Duyckaerts, G.; Dreze, Ph. Translated from Bull. Soc. Chim. Beig.; 71: 306-323(1962). 13p. Dep. NTIS $3.00.

The mechanism of the extraction of trivalent lanthanides and actinides by dibutyl phosphorate is established by taking account of the partition of complexant and its dimerization in organic diluents. The stability constants of the dibutyl phosphates of lanthanides and of certain trivalent actinides were calculated and the extraction is discussed as a function of the atomic number. (auth)

9862 SOLVENT EXTRACTION OF SULFITE COMPLEXES OF METALS. Simonova, T. N.; Shevchuk, I. A.; Malakha, I. N.; Konovalenko, L. I. (Donetsk State Univ., USSR). Zh. Anal. Khim.; 18: No. 9, 1825-1828(Sep 1973). (In Russian).

Sulfite complexes of metals are extracted by high molecular weight primary amines. Sulfite complexes of Cr(III), Fe(III), Fe(II), Cd, Cu, Tb, La were extracted by a chloroform solution of a primary amine fraction (C_{10}–C_{12}). The extraction of a sulfite complex of chromium(III) $(C_{10}H_{21}NH_3)_3Cr(SO_3)_3$ has been studied. (auth)

9863 EXTRACTION OF NIOBIUM AND TANTALUM WITH n-TRIOCTYLAMINE FROM HYDROFLUORIC ACID SOLUTIONS. Pal'shin, E. S.; Ivanova, L. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 18: No. 9, 1741-1745(Sep 1973). (In Russian).

The composition of niobium and tantalum compounds extracted from diluted H_2F_2 solutions with n-trioctylamine has been found to be $[TOAH]HNb(OH)_2F_5$, $[TOAH]HNb(OH)F_6$, $[TOAH]HTaF_7$. The presence of OH^--groups in the complexes extracted has been confirmed by ir spectra. (auth)

9864 SOLVENT EXTRACTION OF Am(III), Eu(III), AND Pu(IV) FROM SOLUTIONS OF COMPLEX-FORMING SUBSTANCES BY 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5 AND ITS MIXTURES WITH DONOR-ACTIVE ADDITIVES. Myasoedov, B. F.; Kochetkova, N. E.; Chmutova, M. K. Zh. Anal. Khim.; 18: No. 9, 1723-1727(Sep 1973). (In Russian).

The solvent extraction of Am and Eu by mixtures of 0.05 M 1-phenyl-3-methyl-4-benzoylpyrazolone-5 (PMBP)–0.025 M trioctylphosphine oxide (TOPO) and 0.05 M PMBP–0.25 M tributyl phosphate in cyclohexane from solutions of complex-forming substances in 0.1 N HNO_3 has been studied. Even large amounts of complex-forming agents do not interfere with the extraction of the elements

by the PMBP–TOPO mixture. Transplutonium elements can be extracted from a solution of a mixture of lactic and diethylenetriaminepentaacetic (DTPA) acids by the extraction with the reagent mixtures after separation of rare earths. The extraction of Am and Pu by PMBP chloroform solutions from a mixture of lactic acid and DTPA has been studied. A method has been developed for radiochemical determination of plutonium after separation of the elements by the extraction with PMBP in the presence of lactic acid and DTPA. (auth)

9865 STUDY OF SORPTION OF CALCIUM AND MOLYBDENUM(VI) IONS BY A CATION-EXCHANGER IN THE PRESENCE OF DIETHYLENETRIAMINEPENTAACETIC ACID. Determination of Calcium Microamounts in Molybdenum-Based Alloys. Zhukova, M. P.; Shemyakin, F. M.; Yakolev, P. Ya., (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Zh. Anal. Khim.; 18: No. 9, 1705-1709(Sep 1973). (In Russian).

The sorption of calcium and molybdenum(VI) ions by the KU-2 cation-exchanger in the NH_4-form from solutions containing diethylenediaminepentaacetic acid has been studied as a function of pH and NH_4Cl concentration. A method has been suggested for determining calcium microamounts in molybdenum-base alloys. (auth)

9866 CHROMATOGRAPHIC ANALYZER DEVICE. Mellac, D.; Rolland, M. L.; Van Kote, F. (to Commissariat a l'Energia Atomique). French Patent 2,138,461. 26 May 1971. 5p. (In French).

A chromatographic analyzer device is described. The device possesses at least one column filled with ion exchanger material, and is provided with means for introducing into the column a sample of the solution being analyzed and then an eluant capable of successively eluating the various elements fixed in the column from the solutions; recipients are provided, which collect the eluant from the column, these recipients being held by a rotating table which enables each recipient to be brought underneath the column in order to collect successive fractions of the eluant in the different recipients; means are provided for heating the recipients (at least when they are in position beneath the column); a suction hood is used to remove vapors liberated by the recipients during heating. This device was designed, particularly, for the treatment of solutions containing noxious elements, such as fission products. (FR)

9867 SOLVENT EXTRACTION OF URANIUM(VI) WITH TRIOCTYLPHOSPHINE OXIDE IN THE PRESENCE OF FATTY ACIDS. Konstantinova, M. (Higher Inst. of Chemical Tech., Sofia); Mareva, S.; Jordanov, N. Anal. Chim. Acta; 68: 237-242(1974).

The influence of fatty acids on the extraction of uranium(VI) with solutions of TOPO in different diluents was studied. The fatty acids used were valeric acid, capric acid, pentadecanoic acid, palmitic acid, and margaric acid. The effect of the acids on the distribution of uranium is antagonistic up to pH 1.9 and synergic above pH 1.9. (LK)

9868 SEPARATION OF THE RARE EARTH ELEMENTS FROM APATITE MINERALS BY DI-(2-ETHYLHEXYL) PHOSPHORIC ACID (HDEHP). Roelandts, I.; Duyckaerts, G. (Univ., Liege). Anal. Chim. Acta; 68: 131-136(1974). (In French).

The liquid–liquid extraction of rare earth elements (REE) by 0.75 M di-(2-ethylhexyl)phosphoric acid (HDEHP) in cyclohexane from perchloric acid (1 to 12 M) was investigated. At moderate perchloric acid molarities (1 to 6 M), the distribution coefficient, E, has an inverse third-power dependency upon the acid concentration in the aqueous phase. However, at higher perchloric acid concentrations, the slope of the resulting curve is about +18, which means a change in the extraction mechanism. In 12 M perchloric acid medium, REE are quantitatively and selectively extracted from apatite minerals, in the organic phase. In order to strip out all the lanthanides, back-extractions were carried out with 9 M hydrochloric acid solutions. (auth)

9869 GEL CHROMATOGRAPHY OF INORGANIC COMPOUNDS. Yoza, N. (Kyushu Univ., Fukuoka). J. Chromatogr.; 86: No. 2, 325-349(21 Nov 1973).

This review demonstrates that gel chromatography is a useful technique for the investigation not only of inorganic polymers of phosphorus, molybdenum, silicon, iron, ruthenium and chromium but also of lower-molecular-weight compounds as small as hydrated metal ions. The article also deals with the applicability of gel chromatography to the investigation of solute–solute interactions such as metal–ligand binding and describes the unusual behavior of eluting agents in gel chromatographic processes. The principle and practice of inorganic gel chromatography are briefly described. (auth)

9870 EXTRACTION OF METAL IONS BY AROMATIC SULFOXIDES. I. Markl, P. (Univ., Vienna). Mikrochim. Acta; No. 6, 907-918(1973). (In German).

The possibilities with regard to the chromatographic and extractive separations that result from the differing solvation of metal species by means of dibenzyl- and diphenyl sulfoxide were studied. The R_f-spectra found for 50 ions in dibenzyl sulfoxide-nitric acid system when subjected to paper chromatography with inverted phases and of 34 ions in the diphenyl sulfoxide-nitric acid system yield a survey of the separation possibilities. The extraction of nitric acid and the extraction of uranyl nitrate from nitric acid aqueous phases in solutions of the two sulfoxides in benzene was studied in batch trials. Both sulfoxides extract nitric acid as the 1:1 complex. Ascending analyses gave the solvation number 2 for the species U(VI), Th(IV), Pd(II), Au(III) and Tl(III) extracted from nitric acid solutions by means of dibenzylsulfoxide. (auth)

9871 ANION EXCHANGE SEPARATIONS OF THE ELEMENTS THAT ARE EXTRACTABLE WITH TRIBUTYL PHOSPHATE. VIII. Koch, W.; Korkisch, J. (Univ., Vienna). Mikrochim. Acta; No. 6, 877-900(1973). (In German).

Firstly consideration is given to the previously known theoretical bases of the ion exchange processes, in particular in organic and water-organic media, whereby such effects that are important to a selective adsorption behavior of the exchanger, such as swelling, solvation, varying distribution of organic materials between resin and solvent phases, complex formation, electroselectivity, and sieve effect are discussed. In the second part of the paper it is established that in the anion exchange behavior of various elements in mixtures consisting of TBP, methyl glycol, and hydrochloric acid with employment of the strongly basic anion exchanger Dowex 1-X8, chloride form, it may come to a competition between two oppositely acting effects, namely of the ion exchanger and the extraction (KIALE-effect). Conditions may be found under which the one or other effect predominates. It is possible to draw and establish conclusions with regard to the distribution of the individual components between resin and solvent agent phase from the adsorption behavior of uranium in mixtures consisting of tributyl phosphate, methylglycol, and hydrochloric acid and an inert diluent, namely that water and methyl alcohol accumulate chiefly in the hydrophilic polar resin phase, whereas TBP, hydrochloric acid and kerosene accumulate chiefly in the nonpolar solvent phase. (auth)

9872 ANIONIC EXCHANGE SEPARATIONS OF THE ELEMENTS THAT ARE EXTRACTABLE WITH TRIBUTYL PHOSPHATE. VII. Korkisch, J.; Koch, W. (Univ., Vienna). Mikrochim. Acta; No. 6, 865-875(1973). (In German).

A method is described for the separation of uranium in which the latter is extracted from a 6 *M* hydrochloric acid solution by means of pure undiluted TBP and adsorbed from a mixture of 30 vol.% TBP, 60 vol.% methylglycol and 10 vol.% of 12 *M* hydrochloric acid on the strongly basic anion exchanger Dowex 1-X8 (chloride form). Since the TBP-extract is used for the preparation of this mixture, the extraction and the ion-exchange may be combined, whereby not only the selectivity of the separation of the uranium is significantly raised but also there follows such a far-reaching enrichment of the uranium on the resin that even ppM quantities are readily determined. For this latter purpose, the resin is first treated with a mixture of 90 vol.% methylglycol and 10 vol.% 12 *M* hydrochloric acid to remove the TBP, and then with 6 *M* hydrochloric acid to remove the co-adsorbed elements; and then the uranium is eluted by means of 1 *M* hydrochloric acid and determined fluorimetrically. For comparison purposes, 16 geologic specimens were analyzed in accord with this procedure and also employing another anion exchange method. The results show that the separation method described here makes possible a quantitative separation of the uranium and leads to good reproducible results. (auth)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 9818, 9909, 10610, 10630, 10714, 10765, 12445, and 12469.

9873 ELECTROMIGRATION OF IONS IN MELTS OF THE SYSTEMS Na_2O-MoO_3 AND Na_2O-WO_3. Ivanov, I. A.; Musakin, D. A.; Shveov, V. P. (Leningrad Technological Inst.). J. Appl. Chem. USSR (Engl. Transl.); 46: No. 5, 1185-1186(May 1973).

Translated from Zh. Prikl. Khim.; 46: No. 5, 1120-1121 (May 1973).

In connection with a study of electromigration of ions in various electrolytes the transference numbers of sodium cations in melts of the compositions $Na_2O \cdot nMoO_3$ and $Na_2O \cdot nWO_3$ (where n = 1.00, 1.25, and 2.00) were determined, and the electromigration behavior of molybdenum and tungsten in them were studied. It was shown experimentally that sodium cations make the main contribution to transport of electricity through $Na_2O \cdot MoO_3$ and $Na_2O \cdot WO_3$ melts. The decrease of the transference numbers of sodium cations in passing from sodium mono- to ditungstate and dimolybdate is probably due to increase of the electronic component of conduction in the melts. ^{22}Na, ^{99}Mo, and ^{185}W were used as tracers in the studies. (LK)

9874 REACTIONS OF α-AMIDINIUM THIOSULFATES (BUNTE SALTS) AND MASS SPECTRA OF α-CHLOROAMIDINES. Devdhar, P. B. Urbana, IL; Univ. of Illinois (1972). 147p. University Microfilms Order No. 73-29,328.

Thesis (Ph. D.).

Synthesis of a number of 2-mercaptoacetamidine hydrochlorides has been reported previously: $HS-CH_2-C(=NH_2^+)NHR\ Cl^-$, 1, the corresponding disulfides, $[-S-CH_2-C(=NH_2^+)NHR]_2\ 2Cl^-$, 2, Bunte salts, $^-O_3SS-CH_2-C(=NH_2^+)NHR$, 3, and phosphorothioates $O_3PS-CH_2-C(=NH_2^+)NHR\ Na^+$, 4, and have found them to be highly effective radioprotective agents. New methods have been developed to synthesize mercaptoacetamidines, 1, and disulfides, 2, from the readily available Bunte salts, 3. A series of mercaptoacetamidines, 1, were prepared by a new method involving the reduction of Bunte salts, 3, by sodium borohydride. The following mercaptoacetamidine hydrochlorides, 1, were prepared by this method (R and yields are quoted): hydrogen (55%); n-nonyl (50%); benzyl (60%); cyclohexyl (52%); 4-t-butylcyclohexyl (40%); 1-adamantanemethyl (80%); 1-(3,5-dimethyl)adamantanemethyl (66%). A number of disulfides, 2, have also been prepared conveniently by extending a previously reported thiourea method. This method involves the reaction of amidine Bunte salts, 3, with thiourea and 1 N HCl at about 80° for 2 hours. Subsequent work gave the disulfides. The following Bunte salts, 3, were converted to disulfides 2, in this manner (R and yields are given): hydrogen (28%); n-nonyl (49%); n-decyl (43%); benzyl (45%); cyclohexyl (50%); 1-adamantanemethyl (80%); β-(1-adamantane thio) ethyl (50%); β-(p-t-butylphenylthio)-ethyl (67%). A number of these compounds related to 1, 2, 3, and 4, have been tested for their radioprotective activity in mice at the Walter Reed Army Institute of Research. Pertinent data is given in the thesis. The disulfide, 2, (R = 1-adamantanemethyl) prepared during the present work has been found to be one of the most highly effective drugs, when administered orally, giving 80% survival at a dose of 50 mg/kg i.e., a dose $\frac{1}{6}$ of its LD_{50}. The LD_{50} for this compound was 325 mg/kg. The mass spectral fragmentation patterns at 70 eV were analyzed for nineteen α(or 2-)-chloroamidines which were examined as their hydrochlorides $Cl-CH_2-C(=NH)NHR \cdot HCl$, 5. For this purpose the chloroamidines were categorized into different classes on the basis of substituent on the nitrogen. (JGB)

Isotope Effects

Refer also to abstracts 9919, 9920, and 10386.

9875 (INIS-mf-839) OPTICAL ACTIVITY DUE TO ISOTOPIC SUBSTITUTION. Kokke, W. C. M. C. (Rijksuniversiteit Leiden (Netherlands)). 29 Mar 1973. 98p. INIS.

The compounds [1R]-2-^{18}O-α-fenchocamphoronequinone and [1R]-[1D]-α-fenchocamphoronequinone with optical activity, due to isotopic substitution of ^{18}O and deuterium, respectively, were prepared and measured with circular dichroism. The electronic spectra of some norcamphorquinones are compared. Two methods of synthesizing optically pure [1R :2R]-1,2-dimethylcyclopentane are discussed, as well as two methods for the determination of optical purity (i.e., circular polarization of luminescence and a photochemical one). (INIS)

9876 SOLVENT ISOTOPE EFFECT ON TRIPLET STATE OF XANTHENE DYES IN H_3BO_3 AND D_3BO_3. Pant, D. D.; Joshi, N. B.; Pant, K. C. (DSB Government Coll., Naini Tal, India). Indian J. Pure Appl. Phys.; 11: No. 4, 301-302(Apr 1973).

The deuterium solvent effect on the xanthene dyes in H_3BO_3 and D_3BO_3 glasses was studied. An increase in both the triplet decay time and the ratio of phosphorescence-to-fluorescence yield was observed due to deuteration. The results are explained on the basis of the nature of the vibrational modes of the solvent molecule. (auth)

9877 MOBILE KETO ALLYL SYSTEMS. XIV. The Kinetics and Mechanism of the Thermal Decomposition of Trans-2-benzal-3-cyclohexylamino-4,4-dimethyl-1-tetralone. Glaros, G. (Russell Sage Coll., Troy, NY); Cromwell, N. H. J. Org. Chem.; 38: No. 25, 4226-4227(14 Dec 1973).

The thermal decomposition of the title compound was found to exhibit first-order kinetics: a large solvent effect, $k_{CHCl_3}/k_{isooctane} = 18$; as well as a primary isotope effect, $k_H/k_D = 2.2$. Possible mechanisms are discussed. (auth)

9878 HYDROLYSIS OF PHOSPHOROGUANIDINES. A Model System for Phosphorylation by Phosphorocreatine. Allen, G. W.; Haake, P. (Wesleyan Univ., Middletown, CT). J. Amer. Chem. Soc.; 95: No. 24, 8080-8087(28 Nov 1973).

The phosphagens are naturally occurring phosphoroguanidinates whose biological role involves the phosphorylation of ADP to give ATP. In an effort to elucidate the mechanism of the in vivo phosphorylation, an in vitro investigation of the fundamental chemistry of several simple phosphoroguanidines was undertaken. The hydrolyses of N,N-dimethyl-N′-phosphoroguanidine (DMPG) and N-benzyl-N-methyl-N′-phosphoroguanidine (BMPG) yield inorganic phosphate and the corresponding guanidinium ion. A bell-shaped pH-rate profile with a rate maximum at pH 2 was obtained for both DMPG and BMPG. The rate law describing this behavior is: rate = $k_0[N]$, where [N] is the concentration of the neutral form of the phosphoroguanidine. At 30.5° the values for the first-order rate constant, k_0, are 3.70×10^{-2} and 2.54×10^{-2} min^{-1} for DMPG and BMPG, respectively. The acidity constants for DMPG are: $K_a^I = 2.04$ and $K_a^{II} = 4.95 \times 10^{-5}$ (determined kinetically); $K_a^{II} = 4.9 \times 10^{-5}$ and $K_a^{III} = 5.0 \times 10^{-12}$ (determined potentiometrically). The values for the solvent deuterium isotope effect, $k(H_2O)/k(D_2O)$, are 0.90 and 0.86 and the values for the entropy of activation, ΔS^*, are +0.4 and −1.2 eu for DMPG and BMPG, respectively. The cationic and anionic forms were found to be at least 10^4 times less reactive than the neutral forms, and the monobenzyl ester of neutral DMPG was found to hydrolyze at least 10^4 times more slowly than neutral DMPG. These results support a mechanism of hydrolysis with the neutral form of phosphoroguanidines as the reactive species and hydrolysis via a unimolecular decomposition to metaphosphate ion, PO_3^-, and guanidinium ion. The most likely mechanism appears to involve proton transfer and formation of a highly reactive double zwitterion which very rapidly produces PO_3^- in the rate-determining step. Although proton transfer may be part of the rate-determining step, the proton must be nearly completely transferred in the transition state. These results are related to the mechanism of biochemical phosphorylation by phosphorocreatine. (auth)

9879 DISPLACEMENT AT PHOSPHORUS BY A MECHANISM WITH A_1 CHARACTER. Acid-Catalyzed Hydrolysis of Phosphinanilides. Tyssee, D. A. (Univ. of California, Los Angeles); Bausher, L. P.; Haake, P. J. Amer. Chem. Soc.; 95: No. 24, 8066-8072(28 Nov 1973).

Studies of the acid-catalyzed hydrolysis of phosphinanilides demonstrate that protonation has a profound labilizing effect on P−N bonds. In H_2SO_4, N-(p-nitrophenyl)diphenylphosphinamide exhibits a kinetic dependence on h_0 with rate law, $v = k[amide]h_0^{0.59}$, and nonlinear dependence of log k on log [acid]. Examination of the dependence of the rate constants on acidity functions indicates an A_1 mechanism: application of the Zucker−Hammett or Bunnett methods requires an acidity function which correctly describes the protonation behavior of the substrate—when log k is plotted vs. H_A, the acidity function for amides, a straight line with slope 1.0 results. This analysis of the dependence of rate on acidity and the large solvent isotope effect, $k_D/k_H = 2.8$, provides strong evidence for an A_1 mechanism. The variation in rate with N-aryl substituents, $\rho = -1.7$, is consistent with a transition state involving the N-protonated species. Although $\Delta S^* = -25$ eu, ΔS^* is a combination of ΔS (protonation) and ΔS (rate-determining step), and an A_1 mechanism is indicated when the entropy of protonation is considered. All of this evidence indicates that, in this case, hydrolysis proceeds by a dissociative mechanism and the transition state must have some of the character of a phosphinylium ion. A mechanism with more associative character is indicated in the acid-catalyzed hydrolysis of N-(phenyl)-methylphenylphosphinamide by the smaller deuterium solvent isotope effect, $k_D/k_H = 2.3$. Acid-catalyzed methanolysis of the (−)-S enantiomer gave optically active, inverted product (−)-(S)-methyl methylphenylphosphinate. These data indicate a merging of associative and dissociative mechanisms in the acid-catalyzed hydrolysis of phosphinamides, with the structure of the transition state dependent upon the nucleophilicity of the leaving group. These results indicate enzymatic labilization of P−N bonds by acid catalysis. (auth)

9880 HYDROLYSIS OF A PHOSPHONIUM SALT. Encounter Limited, Rate-Determining Breakdown of a Pentacovalent Intermediate. Gorenstein, D. G. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 95: No. 24, 8060-8065(28 Nov 1973).

The pH-rate profile for the hydrolysis of 1-methoxy-1-phenyl-

2,2,3-trimethylphosphetanium hexafluorophosphate is presented. The rate of hydrolysis is proportional to the hydroxide ion concentration in the alkaline region, pH > 9, and is pH independent in dilute acid. In the moderate to strong acid region (pH < 1) the rate decreases with increasing acidity, attributable to a decrease in the activity of water. Of major interest is the sigmoidal titration curve between pH 3 and 8, with the rate increasing with increasing pH. This curve is ascribed to a change in the rate-determining step for hydrolysis, from rate-limiting hydration around neutral pH to rate-limiting breakdown of a pentacovalent intermediate in acid. Evidence is presented to suggest that this rate of breakdown of the intermediate approaches a value expected for an encounter-limited proton transfer reaction. (auth)

9881 ACID CATALYZED AND β-GLUCOSIDASE CATALYZED HYDROLYSIS OF 6-PURINYL β-D-GLUCOTHIOPYRANOSIDE. Fedor, L. R.; Murty, B. S. R. (State Univ. of New York, Buffalo). J. Amer. Chem. Soc.; 95: No. 25, 8410-8413(12 Dec 1973).

Hydrolysis of 6-purinyl β-D-glucothiopyranoside (MPG) to 6-mercaptopurine and glucose is catalyzed by hydrogen ion and by almond β-glucosidase. This thioacetal is ca. 10^6-fold more reactive toward hydronium ion than is phenyl β-D-glucothiopyranoside. The dependency of rate on acidity in H_2O and in D_2O suggests that both acidic and neutral forms of MPG undergo acid-catalyzed hydrolysis via the A-1 mechanism. β-Glucosidase catalyzed hydrolysis of MPG in the pH range 3.55–5.95 is characterized by a very shallow bell-shaped V_{max} – pH profile with a maximum at ca. pH 5.3; K_m decreases as pH increases. The deuterium solvent kinetic isotope effect $V_{max}(H_2O)/V_{max}(D_2O)$ = 1 (pH = pD = 5.35). (auth)

9882 ACID CATALYZED AND MERCURIC ION CATALYZED HYDROLYSIS OF 2-(PARA-SUBSTITUTED THIOPHENOXY)TETRAHYDROPYRANS. Fedor, L. R.; Murty, B. S. R. (State Univ. of New York, Buffalo). J. Amer. Chem. Soc.; 95: No. 25, 8407-8410(12 Dec 1973).

Acid catalyzed hydrolysis of 2-(para-substituted thiophenoxy)-tetrahydropyrans is characterized by a proportionality between rate and H_0, a deuterium solvent kinetic isotope effect, k_D/k_H = 1.3, an activation entropy of 7.4 eu, and a ρ value of −0.96. Mercuric ion catalyzed hydrolysis is characterized by a proportionality between rate and $[Hg^{2+}]$, an activation entropy of 45 eu, and a ρ value of 0.88. Rates of mercuric ion catalyzed hydrolysis are ca. 10^2–10^4-fold faster than their acid catalyzed counterparts. The A1 mechanism with protonation or mercuration on sulfur is favored. (auth)

9883 ELCB REACTION OF 1-METHOXYACENAPHTHENE. II. The Elimination Step. Hunter, D. H.; Shearing, D. J. (Univ. of Western Ontario, London). J. Amer. Chem. Soc.; 95: No. 25, 8333-8339(12 Dec 1973).

The stereochemistry of the alkoxide catalyzed elimination reaction of cis- and trans-2-deuterio-1-trideuteriomethoxyacenaphthenes has been investigated as a function of cation in tert-butyl alcohol and in methanol. The relative rates of cis and trans elimination vary by a factor of about 75 from exclusively cis elimination to predominantly trans elimination. Kinetic deuterium isotope effects (α,β and leaving group) have been determined for the preferential cis elimination in tert-butyl alcohol–potassium tert-butoxide. As with the exchange processes ion pairing has been proposed as an important factor in determining the elimination stereochemistry. (auth)

9884 THERMAL DECOMPOSITION OF CYCLOPENTENE AND CYCLOPENTENE-d_8 IN THE GAS PHASE. Knecht, D. A. (Univ. of Rochester, NY). J. Amer. Chem. Soc.; 95: No. 24, 7933-7938(28 Nov 1973).

The thermal decomposition of cyclopentene and cyclopentene-d_8 (72.4% C_5D_8, 23.3% C_5HD_7, 3.7% $C_5H_2D_6$, and 0.6% $C_5H_3D_5$) was studied in the gas phase at 480–530°C and 4–34 Torr in a static system. In the initial phases of the pyrolysis, the reaction proceeds mainly by dehydrogenation to form hydrogen and cyclopentadiene, but at greater extents of decomposition the participation of minor reactions forming ethylene and propylene increases. The first order rate constants for dehydrogenation obtained from pressure increase measurements and from hydrogen analysis can be represented for H_2 and D_2 formation, respectively, by k_H (sec^{-1}) = $(0.63 \pm 0.01) \times 10^{13}$ exp (−57,800 cal mol^{-1}/RT) and k_{D_2} (sec^{-1}) = $(0.99 \pm 0.02) \times 10^{13}$ exp (−60,300 cal mol^{-1}/RT). The analysis of HD/D_2 formed from cyclopentene-d_8 and of H_2/D_2 formed from an equimolar mixture of cyclopentene and cyclopentene-d_8 yields the respective isotope effects k_{HD}/k_{D_2} = (0.82 ± 0.01) exp (1250 cal mol^{-1}/RT) and k_{H_2}/k_{D_2} = (0.637 ± 0.006) exp (2500 cal mol^{-1}/RT). In copyrolysis experiments carried to 5% completion in C_5H_8 and 1.7% completion in C_5D_8, the dehydrogenation reaction appears to be mainly the elimination of a molecule of hydrogen with atomic reactions contributing not more than 2% of the total $H_2 + D_2$. The minor product ethylene was formed with negligible isotopic mixing, whereas propylene exhibited a significant degree of isotopic mixing. (auth)

9885 MEDIUM EFFECTS ON HEAVY-ATOM KINETIC ISOTOPE EFFECTS. II. Cell Model With External–External and Certain External–Internal Coordinate Interactions. Keller, J. H.; Yankwich, P. E. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 95: No. 24, 7968-7972(28 Nov 1973).

The method of Stern, Van Hook, and Wolfsberg for the calculation of vapor pressure isotope effects was applied to model calculations of medium effects on ^{13}C kinetic isotope fractionation in the decompositions (via several reaction coordinates) of a hypothetical nonlinear triatomic; molecular parameters were given values characteristic of organic compounds, while the necessary external force constants were adjusted to yield associated frequencies typical of moderate H bonding (30–90 cm^{-1}). Influences of interactions between external coordinates were studied, as were those between external coordinates and an internal coordinate which was not a component of the reaction coordinate. TAM was selected as the model because of its small size, all such interaction effects decreasing rapidly with increasing molecular mass and complexity. In no case studied would the medium effects calculated be measurable given present techniques; indeed, for molecules of ordinary mass and complexity, such effects would not even be a detectable increment or decrement to isotope rate effects determined with reasonable precision. Because the effects are additive, subject to certain restrictions, it is possible that medium effects of experimental significance could be produced if: the isotopic molecules were relatively light; reaction temperatures were low (say, below 25°C); solvent–solute interactions were drastically different in magnitude in reaction and transition states; one or more of the component interactions includes coupling to an internal coordinate (preferably isotopic) which is part of the reaction coordinate; and the force constants associated with such interactions are substantially larger than those employed here. If the last two conditions are met, the assumptions of the cell model will have been strained and some more natural technique for handling such strong interactions should be attempted. (auth)

9886 LACTONIZATION OF COUMARINIC ACIDS. Kinetic Evidence for Three Species of the Tetrahedral Intermediate. Hershfield, R.; Schmir, G. L. (Yale Univ., New Haven). J. Amer. Chem. Soc.; 95: No. 24, 8032-8040(28 Nov 1973).

The lactonization of four coumarinic acids substituted on the ring and side chain with methyl groups has been studied at 30°C and at pH 0–7. The variation of the rate of lactonization with pH is strongly dependent on the position of the methyl substituents. With 4,6,8-trimethylcoumarinic acid, the pH-rate profile is consistent with the participation of three kinetically significant intermediates, and provides kinetic evidence for the existence of an anionic tetrahedral intermediate in the formation of a phenyl ester. The nonlinear dependence of the rate of lactonization of coumarinic acids on formate and acetate buffer concentration offers additional support for the postulation of intermediates in these reactions. (auth)

9887 DETERMINATION OF RATE CONSTANTS FOR THE REACTIONS OF OH WITH PROPYLENE AND ETHYLENE BY A PULSED PHOTOLYSIS FLUORESCENCE RESONANCE METHOD. Stuhl, F. (Univ., Bochum, Ger.). Ber. Bunsenges. Phys. Chem.; 77: No. 9, 674-676(1973).

Absolute rate constants for the reactions of OH radicals with CH_3CHCH_2, CD_3CHCH_2, CH_3CDCD_2, and CH_2CH_2 were determined at 298°K. Hydroxyl radicals were generated in the pulsed vacuum-uv photolysis of H_2O. Decays of OH were monitored by resonance fluorescence in an excess of hydrocarbons. The rate constants for the reactions with propylene and ethylene were determined to be $1.45 \pm 0.22 \times 10^{-11}$ and $3 \pm 1 \times 10^{-12}$ cm^3 $molecule^{-1}$ sec^{-1}, respectively. The kinetic isotope effect for deuterated propylene was found to be small, thus supporting the proposed addition mechanism. (GE)

9888 KINETIC ISOTOPE EFFECTS IN VARIOUS SOLVENTS FOR THE PROTON-TRANSFER REACTIONS OF 4-NITROPHENYLNITROMETHANE WITH BASES. Caldin, E. F.; Mateo, S. (Univ. of Kent, Canterbury, Eng.). J. Chem. Soc., Chem. Commun.; No. 22, 854-855(21 Nov 1973).

The kinetic isotope effect for the proton transfer reactions between 4-nitrophenylnitromethane and the bases tetramethylguanidine, tri-n-butylamine, and triethylamine is markedly dependent on the solvent; for the reaction with tetramethylguanidine in toluene, exceptionally large values are found for the rate ratio at 25° (k^H/k^D = 45 ± 2) and for the ratio of the Arrhenius A-factors (A^D/A^H = 31 ± 8), and quantum-mechanical tunnelling is used to explain them. (auth)

9889 KINETIC STUDY OF CHLORINE-ISOTOPIC EXCHANGE BETWEEN LITHIUM CHLORIDE AND DI- AND TRI-NITRO-DERIVATIVES OF M- AND P-DICHLOROBENZENES. Gore, P. H.; Hammond, S. D.; Morris, D. F. C. (Univ. of Brunel, London). J. Chem. Soc., Perkin Trans., II; No. 14, 1883-1887(1973).

The kinetics of chlorine isotopic exchange between di- or trinitro-derivatives of m- or p-dichlorobenzene with $Li^{36}Cl$ were measured. Second-order rate constants for 1,3-dichloro-4,6-dinitrobenzene increase in the sequence of solvents; isopropyl alcohol ≪ acetylacetone < sulpholan < dimethyl sulphoxide < 97:3 (v/v) diethyl ketone-n-butanol < acetone < hexamethylphosphoramide < diethyl ketone. No exchange was observed for dioxan or glacial acetic acid solutions. Water exerts a strong retarding effect on the rate of exchange of this substrate in acetone solution. Rate-constants relative to 1-chloro-2,4-dinitrobenzene = 1.00, at 298°K in anhydrous acetone solution were: 1,3-dichloro-2,4-dinitrobenzene 0.019, 1,4-dichloro-2,6-dinitrobenzene 0.61, 1,3-dichloro-4,6-dinitrobenzene 26, and 1,3-dichloro-2,4,6-trinitrobenzene 32,000. With 1,3-dichloro-2,4-dinitro- and 1,4-dichloro-2,6-dinitrobenzene only the 1-chloro-groups undergo exchange, under the conditions used. (auth)

9890 THERMAL DECOMPOSITION OF TERTIARY ALKYL PEROXIDES. Substituent Effects in Peroxide Bond Homolysis and β Scission of Alkoxy Radicals. Richardson, W. H.; Yelvington, M. B.; Andrist, A. H.; Ertley, E. W.; Smith, R. S.; Johnson, T. D. (California State Univ., San Diego). J. Org. Chem.; 38: No. 25, 4219-4225(14 Dec 1973).

Rate coefficients for the thermal decomposition of a series of substituted tertiary alkyl peroxides in chlorobenzene at 150° were obtained. The sum of the polar substituent constant ranged over approximately one unit for the peroxides to give $\log k + 4 = (-0.131 \pm 0.030)\Sigma\sigma^* + 0.578$. From this correlation, the reaction constants ρ_1 and f were calculated to be −0.291 and −0.175, respectively. The corresponding reaction constants for meta-substituted benzoyl peroxides, obtained from a multiple-linear-regression analysis of published data in dioxane at 80°, are $\rho_1 = -0.327$ and $f = -0.174$. For comparison to alkyl peroxides, the latter values were corrected to 150°, where $\rho_1 = -0.273$ and $f = -0.145$. Considering the change in solvent and approximations in relating alkyl peroxide and benzoyl peroxide reaction constants, there appears to be little difference in substituent effects between these two types of peroxides. Alkyl peroxides of the type $(CH_3)_3COOC(CH_3)_2R$ with R = CH_2OH (7) or COOH (8) showed unusually fast rates of decomposition and enhanced yields of tert-butyl alcohol. The alcohol 7 also showed a small deuterium isotope effect ($k_H/k_D = 1.35$). Mechanistic schemes are considered to explain the kinetic data, as well as the products from 7 and 8. Substituent effects in β scission of unsymmetrically substituted tert-alkoxy radicals, produced from alkyl peroxides, are reported. These data are considered in terms of a Polanyi relationship. (auth)

9891 MECHANISMS OF ELIMINATION REACTIONS CATALYZED BY WEAK BASES. Ford, W. T. (Univ. of Illinois, Urbana). Accounts Chem. Res.; 6: No. 12, 410-415(Dec 1973).

Substitution of deuterium for hydrogen at C_β enables determination of primary kinetic isotope effects k_H/k_D for elimination and secondary isotope effects for substitution of alkyl halides and sulfonates. (LK)

9892 DEUTERIUM ISOTOPE EFFECT IN ELECTRON IMPACT DESORPTION OF HYDROGEN FROM TUNGSTEN. Jelend, W.; Menzel, D. (Technische Univ., Munich). Vide; 28: No. 164, 86-87(Mar 1973).

The deuterium isotope effect on electron impact desorption cross sections was measured for two adsorption states of hydrogen on polycrystalline tungsten having widely differing cross sections. (FR)

9893 KINETIC SOLVENT ISOTOPE EFFECT ON THE REDOX REACTION OF U(IV) IONS WITH FERRICYANIDE IONS. Treindl, L.; Adamcikova, L. (Komensky Univ., Bratislava). Chem. Zvesti; 27: No. 4, 433-436(1973).

The kinetic solvent isotope effect on the redox reaction of U(IV) ions with ferricyanide ions was studied. The measured temperature-dependent values of k_{H_2O}/k_{D_2O} as well as the values of $\delta\Delta H^+$ and $\delta\Delta S^+$ were interpreted from the point of view of the proposed reaction mechanism. The increase in activation enthalpy in heavy water by 2.5 kcal mol^{-1} when compared with light water supports the idea of the electron transfer between U(IV) and $HFe(CN)_6^-$ ions by the –OH (or –OD) bond mechanism. (auth)

9894 MONTE CARLO CALCULATIONS OF REACTION RATES AND ENERGY DISTRIBUTIONS AMONG REACTION PRODUCTS, F + HD → HF + D, AND F + HD → DF + H. Wilkins, R. L. (Aerospace Corp., El Segundo, CA). J. Phys. Chem.; 77: No. 26, 3081-3084(20 Dec 1973).

Rate constants are calculated for the exothermic reactions F + HD(v,J) → HF(v′) + D and F + HD(v,J) → DF(v′) + H by analyzing the results of three-dimensional classical trajectories on an assumed London-Eyring-Polanyi-Sato (LEPS) potential energy surface. The Monte Carlo method is used to start each collision trajectory. An analysis is given of the dependences of the total reaction cross sections σ_r and specific reaction cross sections $\sigma(v, J, v', E_R)$ on the relative translational energy and the vibrational-rotational energy of the reagent molecule HD(v, J). Data are presented for the temperature dependences of (1) the overall rate constants, (2) the rate constants for the formation of HF and DF in specified vibrational states, and (3) the distribution of vibrational, rotational, and translational energies in the products of these exothermic reactions. The relative rate constants at room temperature for the formation of HF and DF in specific vibrational states are (1) for F + HD → HF(v′) + D, $k(v' = 1) = 0.26$, [$k(v' = 2) = 1.00$], and $k(v' = 3) = 0.67$; and (2) for F + HD → DF(v′) + H, $k(v' = 2) = 0.15$, [$k(v' = 3) = 1.00$], and $k(v' = 4) = 0.62$. Each reaction exhibits a high fractional conversion of available reaction energy into vibrational energy of the newly formed molecule. The mean fractions of available energy-entering vibration plus rotation are (1) for F + HD → HF(v′) + D, $f_{v'} + f_{R'} = (0.77 + 0.12) = 0.89$, and (2) for F + HD → DF(v′) + H, $f_{v'} + f_{R'} = (0.67 + 0.20) = 0.87$. The isotopic analogs of the reaction between atomic fluorine and H_2 all have similar energy distributions of the reaction products, but the relative rate constants for formation of product molecules in specified vibrational states are different. The overall rate constants at room temperature for the two reactions between F and HD indicate that the fluorine atom abstracts the hydrogen atom from HD about 1.5 times as fast as it abstracts the deuterium atom from HD. (auth)

9895 SINGLET EXCITONS IN PURE AND MIXED BENZENE CRYSTALS. Netzel, T. L. New Haven; Yale Univ. (1973). 176p. University Microfilms Order No. 73-19,034.

Thesis (Ph.D.).

Previous solid state experiments suggested that there was a temperature-independent density-of-states for the $^1B_{2u}$ electronic state of benzene. Therefore, the first work done was to definitely establish this fact and to make as accurate a determination of this density-of-states as possible. Extensive attempts were then made to extract the correct values of the pairwise interactions by varying the pairwise interaction parameters and computing densities-of-states for comparison with the experimental data. The results of this process were not definitive. A Green's function technique was used to calculate the properties of heavily doped, molecular crystals. In order to perform the calculations of the properties of these mixed crystals, it was necessary to first have the pure crystal density-of-states from the above mentioned work. Three systems were chosen for study, C_6H_6/C_6H_5D, $C_6H_6/C_6H_4D_2$, and C_6H_6/C_6D_6. The quantities calculated for these systems were the partial densities of states of each binary mixture component, the K = 0 spectral density function which is expected to be closely related to the absorption spectrum and the band-to-band emission spectrum at various temperatures. The absorption spectra for C_6H_6/C_6H_5D and C_6H_6/C_6D_6 systems were measured. The agreement with theory for the C_6H_6/C_6H_5D system was very good and a systematic deviation for the C_6H_6/C_6D_6 system was found. This latter result prompted a study of the Davydov splittings in pure C_6D_6 which was now available at a higher level of isotopic purity than that previously studied. The absorption experiments on pure C_6D_6 and on 5% C_6D_6 in C_6H_6 established the position of the mean of the C_6D_6 band. Although the mean of the C_6D_6 band was 203 wave-numbers higher in energy than the mean of the C_6H_6 band, the positions of the Davydov components relative to the band mean were the same in neat C_6D_6 as in neat C_6H_6. Therefore it was concluded that the isotope effect found in the C_6H_6/C_6D_6 mixed crystal system arose from a postulated difference in the volumes of the unit cells between neat C_6H_6 and neat C_6D_6. Finally a limited number of emission experiments for the C_6H_6/C_6H_5D system were performed. They show that even at 4.6 degrees Kelvin, the emission originates from states in which both types of molecules participate. Another way of stating this is to say that the high energy component (C_6H_5D) has mixed throughout the band, even to the low energy edge, as the calculations predicted. (Diss. Abstr. Int., B)

9896 POLARITY OF VAN DER WAALS MOLECULES. Novick, S. E.; Davies, P. B.; Dyke, T. R.; Klemperer, W. (Harvard Univ., Cambridge, MA). J. Amer. Chem. Soc.; 95: No. 26, 8547-8550(26 Dec 1973).

The polarity of a number of loosely bound complexes is qualitatively measured by molecular beam electric deflection. The following species are observed as polar: ArNO, ArHCl, NeDCl, XeHCl, $ArBF_3$, $KrBF_3$, $(NO)_2$, $(HCl)_2$, BF_2NO, BF_3CO, $(CO_2)_2$.

Among the species observed to be nonpolar are: $(NO)_3$, $(NO)_4$, N_2O_2, NeHCl, COH_2, $(BF_3)_2$, $(BF_3)_3$, $(BF_3)_4$. Structural interpretations of these results, together with some preliminary radiofrequency spectroscopy, are presented. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 9804.

9897 (CEA-CONF-2445) NEW APPROACH TO THE STUDY OF AQUEOUS SOLUTIONS OF CO_2. Gerstar, R. H.; Maren, T. H.; Silverman, D. N. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France); Florida Univ., Gainesville (USA). Coll. of Medicine). 1973. 20p. (CONF-730525-4). Dep. NTIS (U. S. Sales Only) $3.00.

From 1st international conference on stable isotopes in chemistry, biology, and medicine; Argonne, Illinois, USA (9 May 1973).

Carbon-13 and oxygen-18 were used to study the behavior of CO_2 aqueous solutions as functions of pH, temperature, and the presence of carbonic anhydrase. (LK)

9898 (NRCN-349) EXCHANGE BETWEEN HYDROGEN ATOMS OF DISSOLVED NAPHTHALENE AND GASEOUS ISOTOPIC HYDROGEN (TRITIUM). Pri-bar, I. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Weizmann Inst. of Science, Rehovoth (Israel)). Aug. 1972. 65p. (In Hebrew). INIS.

Thesis.

The tritiation of aromatic hydrocarbons by means of tritium gas is performed in DMSO solution and is catalyzed by K_2PtCl_4. The exchange reaction with naphthalene in the absence of a catalyst is of the first order with respect both to the aromatic compound and the tritium gas. In the presence of the homogeneous catalyst, the reaction is of zero order with respect to the naphthalene. (INIS)

9899 ELCB REACTION OF 1-METHOXYACENAPHTHENE. I. The Nature of the Carbanion-Forming Step. Hunter, D. H.; Lin, Y. T.; McIntyre, A. L.; Shearing, D. J.; Zvagulis, M. (Univ. of Western Ontario, London). J. Amer. Chem. Soc.; 95: No. 25, 8327-8333(12 Dec 1973).

The stereochemistry of the alkoxide catalyzed H-D exchange component of the Elcb reaction of 1-trideuteriomethoxy-1,2,2-trideuterioacenaphthene (1) has been investigated as a function of cation in tert-butyl alcohol and methanol. Isotopic exchange occurred almost exclusively at the position β to the methoxy with a β/α rate ratio of about 50 and a ratio of about five powers of ten faster than exchange in the aromatic ring. The relative rates of cis and trans exchange at the β position changed by a factor of about 90 when the cation was varied; lithium, potassium, cesium, tetramethylammonium, and potassium complexed with crown ether. Bonding between base, substrate, and cation has been proposed to account for the observed trends in β exchange. (auth)

9900 STEREOCHEMISTRY OF BASE-CATALYZED HYDROGEN EXCHANGE IN CYCLIC SULFONIUM SALTS. Hofer, O. Eliel, E. L. (Univ. of Notre Dame, IN). J. Amer. Chem. Soc.; 95: No. 24, 8045-8050(28 Nov 1973).

The relative rate constants of successive H/D exchange at carbons next to sulfur for the four α-methylene hydrogens in thiacyclohexylmethylsulfonium iodide (3) and thiacyclopentylmethylsulfonium iodide (2) with sodium deuterioxide in D_2O have been measured. The reactivity ratio for the two pairs of diastereotopic hydrogens in the six-membered ring (3) is near 1:1, but in the five-membered ring (2) it is ca. 12:1. The corresponding ratio for the two diastereomeric 2-methylthiacyclohexylmethylsulfonium salts 4 and 5 at the methylene carbon is about the same as for the parent compound 3. The results for the thiacyclohexyl compound 3 agree with those found by others but those for the thiacyclopentyl compound 2 are only in qualitative agreement, the selectivity being less by a factor of over 30 than reported earlier. The findings are discussed in relation to the present status of the gauche effect. (auth)

9901 CONFORMATIONAL ANALYSIS OF THE THIOLANE RING SYSTEM. I. Stereochemistry of the Base-Catalyzed H-D Exchange, Pyramidal Inversion, and Proton Magnetic Resonance Spectrum of Trans-3-Methyl-3-Thioniabicyclo[4.3.0]nonane Iodide, a Conformationally Rigid Thiolanium Cation. Barbarella, G.; Garbesi, A.; Boicelli, A.; Fava, A. (CEN, Grenoble, France). J. Amer. Chem. Soc.; 95: No. 24, 8051-8056 (28 Nov 1973).

The PMR spectrum of the title compound (II) can be analyzed by a first-order procedure. The compound undergoes stereospecific base-catalyzed exchange of the α ring protons, whose reactivities are found to be approximately in the ratio 200:3:3:1. Nuclear Overhauser experiments on specifically deuterated samples indicate the faster proton to be cis to the S-methyl group. This stereochemical assignment together with the values of the vicinal coupling constants disclose the stereochemistry of the heterocyclic part of II. Certain consequences of this stereochemistry are discussed. The stereospecificity of the H-D exchange is discussed in relation to its significance in terms of the stereochemistry, retention or inversion, of the exchange, as well as in relation to the Wolfe and Czimadia theory on the conformational energy of species having adjacent lone pairs. Finally, the availability of a specifically deuterated sample has permitted the observation of the occurrence of thermal pyramidal inversion of the sulfur atom, and the measurement of the rate of this process. (auth)

9902 ACID-CATALYZED AND ALKALINE HYDROLYSES OF PHOSPHINAMIDES. The Lability of Phosphorus-Nitrogen Bonds in Acid and the Mechanisms of Reaction. Koizumi, T.; Haake, P. (Wesleyan Univ., Middletown, CT). J. Amer. Chem. Soc.; 95: No. 24, 8073-8079(28 Nov 1973).

The chemical dynamics of the hydrolytic cleavage of the P-N bond in phosphinamides, $R_2P(O)NR'_2$ (R' = H, CH_3), have been studied. The results reflect on the fundamental nature of the P-N bond and therefore are relevant to understanding phosphorus amides as solvents, synthetic intermediates, and phosphate transfer agents in biochemistry. Phosphinamides undergo alkaline hydrolysis of analogous carboxylic amides. Oxygen-18 studies of the basic hydrolysis reveal a small amount of ^{18}O exchange into unhydrolyzed amide: k(hydrolysis)/k(exchange) = 70. This may provide direct evidence for a pentacoordinate intermediate in the mechanism of alkaline hydrolysis. Although phosphinamides are no more reactive toward hydroxide than carboxylic amides, these amides hydrolyze in acidic solutions about 10^3 times more rapidly than carboxylic amides. In order to elucidate the source of this rate enhancement, a study was made of the hydrolysis of N-substituted diphenylphosphinamides (1), N,N-dimethyl-2,2,3,4,4-pentamethyltrimethylenephosphinamide (2), and N,N-dimethyldiisopropylphosphinamide (3). In acidic media, specific acid catalysis was observed for 1 in the pH range 1.5-3.5. The low solvent isotope effect, $k_D/k_H = 1.3$, and the highly negative activation entropy, $\Delta S^* = -35$ eu, indicate an A_2 mechanism. Partial hydrolysis in acidic $H_2{}^{18}O$ introduced 1 equiv of solvent oxygen into diphenylphosphinic acid. The variation in rate with nitrogen substituents, $\rho^* = -1.0$, is consistent with a mechanism involving the N-protonated species, and it is the tendency to protonate on nitrogen that appears to be the source of the lability of phosphorus amides. Introduction of angle strain at phosphorus in 2 produced a marked inhibition of hydrolysis: 2 reacts 10^3 times more slowly than its open-chain analog, 3. This unusual retarding effect of small ring geometry in displacement at phosphorus together with the evidence for N-protonation indicates a process involving direct displacement rather than a pentacoordinate intermediate with significant stability. (auth)

9903 ISOTOPIC EXCHANGE KINETICS BETWEEN DIBENZOYLMETHANE-^{14}C AND ITS TRIS-TYPE COMPLEX WITH ALUMINUM(III) IN TETRAHYDROFURAN. Matsuzawa, K.; Saito, K. (Tohoku Univ., Sendai). Bull. Chem. Soc. Jap.; 46: No. 9, 2777-2779(Sep 1973).

Isotopic exchange kinetics between [Al(dbm)$_3$] and Hdbm-^{14}C (dbm^-, anion of dibenzoylmethane in enol form) was studied in tetrahydrofuran (THF) at 30 to 55°C. During several half lives the McKay plot gives straight lines, the AB spectrum remaining unchanged. The rate is very small in the absence of catalysts, and accelerated by water and trichloroacetic acid, but not by weak acids and pyridine. The rate is expressed by R = [complex] k_2 $[H_2O] + k'_3$ [acid] + k_3 [acid][H_2O]. The Arrhenius plots of k_2, k'_3, and k_3 give an equal ΔH^* value 25.6 kcal/mole. It appears one of the ligands is present as unidentate in the intermediate state, and the break of the remaining bond is the rate-determining step. (auth)

9904 SEPARATION OF RADIOCOBALT BY ISOTOPE EXCHANGE ON COBALT(III) α-NITRO-β-NAPHTHOLATE. Rakovic, M.; Glagolicova, A. (Charles Univ., Prague). Radiochem. Radioanal. Lett.; 15: No. 6, 387-391(19 Dec 1973).

Preliminary results are presented on the separation of ^{58}Co by isotope exchange with stable Co of cobalt(III) α-nitroso-β-naphtholate. The possibility of separating radiocobalt with high yields (97%) was demonstrated. Sorption of iron(III) ions was also discussed. (auth)

Feed Materials Processing

Refer also to abstract 9803.

9905 (INIS-mf-894) REVERSE PRECIPITATION OF AMMONIUM DIURANATE FROM URANYL SULFATE SOLUTIONS.

Abrao, A.; de Araujo, J. A.; Franca, J. M. Jr. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1972. 12p. (In Portuguese). INIS.

A technique for the production of nuclear-grade ammonium diuranate (ADU) using uranyl sulfate solutions obtained as eluate from the ion exchange (strong cationic resin) purification of uranium, by precipitation with NH_3 gas is described. The precipitation of ADU by direct introduction of NH_3 gas into acid uranyl sulfate solution has as a consequence a high coprecipitation of sulfate ion, reaching ratios as high as 10 to 14% $SO_4^=$/ADU. To overcome this serious inconvenience the reverse order of addition of reagents was studied, the ADU precipitation being done in such a way that the pH of the mixture was kept higher than 6 during the whole precipitation. This modification, in conjunction with the adjustment of other precipitation parameters, like temperature, precipitation time, concentration of uranium in uranyl sulfate and pH, allowed a successful precipitation of ADU with low sulfate content. The technique was applied at pilot-plant scale, using batch and continuous precipitation; in both cases the obtained ADU was low in sulfate. (INIS)

9906 (INIS-mf-925) AMMONIUM DIURANATE CONTINUOUS PRECIPITATION FOR THE PRODUCTION OF CERAMIC UO_2. de Araujo, J. A. (Sao Paulo Univ. (Brazil). Escola Politecnica). 1971. 113p. (In Portuguese). INIS.

Thesis.

A study was made of the ammonium diuranate continuous precipitation, with a high chemical purity degree, from uranyl nitrate solutions that are leaving the stripping column at the pilot plant of uranium purification with solvents. The main purpose is the comparison of the results obtained from the continuous process, described here and those from the batch precipitation process in use presently, and the achievement of the maximized operational conditions for the best process yield in the ADU production as well. The precipitations were done by a continuous procedure in two different ways. Initially, two in-line reactors were used. The first one was fed with an uranyl nitrate and ammonium hydroxide of known title, until a desired pH was achieved; the second one where the precipitation itself was done. With the results obtained from the experiments in both reactors, a new set of experiments was done, but using only one reactor, varying the precipitating agent (NH_4OH and NH_3). In some runs EDTA was also used as a complexing agent for impurities which could remain in the uranyl nitrate. The experimental work here performed and the data obtained permit the design of a chemical reactor for the continuous nuclear grade ADU precipitation using the uranyl nitrate solution leaving the stripping column (3rd pulsed column) at the Chemical Engineering Division solvent extraction Pilot Plant. The new reactor is ready for use and will substitute the former reactor (batch precipitation). (INIS)

9907 (TRITA-MEL-8) BACTERIAL LEACHING OF URANIUM SHALE. Bjoerling, T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden)). Sep 1973. 20p. (In Swedish). Dep. NTIS (U.S. Sales Only) $3.00.

By the bacterial leaching of Swedish uranium shale with Thiobacillus ferrooxidans it has been found possible, contrary to the usual air oxidation and acid leaching, to combine the two chemical conditions for efficient uranium leaching, namely high redox potential and low pH. These conditions are both produced at the bacterial breakdown of shale pyrite. The breakdown of pyrite has been found to occur either by bacterial attack at optimum pH and temperature or by chemical attack from ferric iron at high temperature. A flowsheet for shale treatment is suggested in which good extraction of uranium can be combined with pyrite breakdown. It includes: bacterial leaching at pH 2 adjusted with lime (N3 days), mainly inorganic leaching at spontaneous pH 1.5 (N3 days), and inorganic leaching at 75°C (1 day). The treatment of shale pulp with 50% density requires about one week and gives 75% uranium yield; there is practically no pyrite left in the residue. With a uranium production of 120 tons/year, the total tank volume is assessed to about 17,000 m^3. (auth)

Radiation Chemistry

Refer also to abstracts 9887, 10347, and 11942.

9908 (COO-3118-4) EFFECTS OF MERCAPTANS AND DISULFIDES ON PHOTOCHEMICAL AND HIGH ENERGY RADIATION INDUCED REACTIONS. Progress Report, November 1, 1972–October 31, 1973. Cohen, S. G. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Chemistry). 1973. Contract AT(11-1)-3118. 31p. Dep. NTIS $3.75.

The ^{60}Co γ radiolysis of dilute aqueous methyl acetate was studied. Initial reactions may be HO + $CH_3CO_2CH_3$ → $\cdot CH_2CO_2CH_3$ (III) + $CH_3CO_2CH_3$ · (IV) + H_2O (1); H + $CH_3CO_2CH_3$ → (III) + (IV) + H_2 (2); e^-_{aq} + $CH_3CO_2CH_3$ → $CH_3C(O^-)OCH_3$ I^- → $CH_3C(OH)OCH_3$ (II) (3); and e^-_{aq} + $CH_3CO_2CH_3$ → $CH_3C(OH)(O^-)OCH_3$ + H· (4). Disappearance of methyl acetate and formation of products were studied. H_2 may also arise from disproportionation of II, H_2 is decreased by mercaptan, H_2O_2 and formate. (auth)

9909 (NRCN-310) SPECTRUM AND CHEMICAL PROPERTIES OF Pr(IV) IN AQUEOUS SOLUTIONS. Feder, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Weizmann Inst. of Science, Rehovoth (Israel)). Aug 1972. 48p. (In Hebrew). INIS.

Thesis.

When an N_2O-saturated neutral solution of Pr(III) is irradiated, an intermediate product is formed, with a strong absorption maximum at 290 nm. When using oxygen-saturated solutions, absorption is less (at 300 nm, for example, O.D. = 0.165 and 0.089 for N_2O and O_2 saturated solutions, respectively). These results justify the assumption that the OH radicals produced during radiolysis react with Pr(III) to yield Pr(IV). This reaction constant is determined in five different methods. One determines it from the first-order intermediate product at 300 nm, not taking into account the competitive reaction of the OH radicals recombination. Two other methods determined the reaction rate constant from the 1/O.D. graph gradient against 1/[Pr(III)] or 1/[OH] . In these two methods, we used the equation derived from kinetic analysis of the two competitive reactions: OH + OH, OH + Pr(III). Other determinations of the reaction rate constant were done by the competitive method with H_2O_2 and CNS^-. All five methods gave values of $1-4\times10^6 M^{-1}\ sec^{-1}$. The value chosen as the reaction rate constant, was $2\times10^6 M^{-1}\ sec^{-1}$. In the 250–800 nm region spectrum of Pr(IV) there is an absorption band, whose maximum at 290 nm, with an absorption coefficient (ε) of 1400 $M^{-1}\ cm^{-1}$ and a saddel point which results probably, from another maximum, is lower and at 500 nm $\epsilon\times 100\ M^{-1}\ cm^{-1}$. The higher absorption band is explained as an f-d transition. It is assumed that the lower one is charge transfer. In acidic solutions the absorption of Pr(IV) is considerably lower. This can be explained if assumed that Pr(IV) is hydrolyzed and the spectrum of a neutral solution is of $PrOH^{+3}$ and in an acidic solution of Pr^{+4}. The equilibrium constant of the hydrolysis reaction is determined by measuring the absorption at various pH. The value determined is 7×10^{-4}. Decay of Pr(III) in water in neutral solutions is a second-order reaction, with a reaction rate constant of $1.5\times10^8 M^{-1}\ sec^{-1}$. In acidic solutions the decay of Pr(IV) is pseudo-first order reaction with a second order reaction rate constant of $6\times10^6 M^{-1}\ sec^{-1}$, as a result of the Pr(IV) reaction with HSO_4^-. The reaction rate constants were determined for the reaction of Pr(IV) with different reduction agents (Br^-, H_2O_2, NO_2^-) and the reaction rates of the reaction of Pr(III) with H and e^-_{aq}. (INIS)

9910 (NRCN(LS)-342) RADIATION CHEMISTRY OF POLYMERS. Literature Survey, 1960–1971. Leopold, J. G.; Paraggi, M. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Jul 1973. 28p. (In Hebrew). INIS.

The literature on radiation chemistry of polymeric materials has been summarized. The applicability of the published data to radiation damages was considered. (auth)

9911 (ORNL-TM-4403) TESTS OF THE STABILITY OF DOWTHERM A AT 600°F WITH RADIATION DOSES UP TO 10^6 RAD. Smith, A. M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 65p. Dep. NTIS $5.25.

Tests were conducted to obtain data on the thermal stability of Dowtherm A when heated to 600°F and (1) subjected to varying gamma radiation dose rates in static capsules and (2) subjected to a constant dose rate while undergoing a phase change in the boiler of a Rankine cycle system. Results from the static capsules showed that radiation doses up to 7.8×10^5 rad had little if any effect on the noncondensable gas formation rates and that chemical purity is an important factor in decomposition rates of Dowtherm A. Data from the Rankine cycle system tests were inconclusive; however, they did indicate gas formation rates approximately 3 orders of magnitude greater than those of the capsule tests. This increase appeared to stem, at least in part, from malfunctions in the pumps which caused local overheating. (auth)

9912 (ORO-2001-29) RADIATION INDUCED EFFECTS IN ORGANIC SYSTEMS. Progress Report, December 1, 1972–December 1, 1973. Johnsen, R. H. (Florida State Univ., Tallahassee (USA)). 1973. Contract AT(40-1)-2001. 14p. Dep. NTIS $3.00.

Research progress is reported in the following areas: studies on radical kinetics in systems exhibiting a mesophase (production and decay of radicals in p-azoxyanisole); radical decay processes

in amino acid crystals; and interactions of molecular ions with metal surfaces. (DHM)

9913 (STU-69-488-U-355) INTRODUCTORY STUDIES ON THE POSSIBILITIES OF ELIMINATING ODOROUS AIR POLLUTANTS IN KRAFT MILL GASEOUS EFFLUENTS BY IONIZING RADIATION OR ELECTRICAL DISCHARGES. Bjellqvist, B.; Eriksen, T. E.; Widen, B.; Westermark, T. (Styrelsen foer Teknisk Utveckling, Stockholm (Sweden)). Jul 1971. 29p. (In English and Swedish). Dep. NTIS (U.S. Sales Only) $3.50.

It has been suggested that, due to the reactivity of the sulfhydryl groups, the malodorous air pollutants from kraft mills might be removed by radiation catalyzed oxidation. Thus the radiolytic effect of γ radiation from ^{60}Co source on methylmercaptan in air was studied. Also, the oxidation of hydrogen sulfide and methylmercaptan, using the radiomimetic gas O_3 was investigated. The depletion of methylmercaptan, in the concentration range <200 ppM by radiation corresponds to the relatively high G value 15 to 20, which indicates a short radical chain reaction. The nitrogen oxides formed by irradiation seems to act catalytically. The main product was found to be methanesulfonic acid. The G value seems to increase with increasing mercaptan concentration. Thus, if the G value is assumed to be constant even at very low mercaptan concentration, approximately 3 Mrad is needed to deplete a mercaptan concentration of 3000 ppM to concentrations below the detection level (0.02 pphM). Ozone was not found to initiate a chain reaction, and is required in excess to suppress the formation of dimethyl disulfide. The results obtained shows that it is not economic feasible to use γ radiation. It seems however possible to use a small electron accelerator with a few keV electron energy or electric discharges. The electric energy corresponding to a dose of 3 Mrad is approximately $30^{W_s}/l$ gas. A calculation based on 200 m^3/min gas, 1000 ppM sulfur gives 40,000 kr/year. It is probably necessary to pass the gas through an absorption tower to remove the methanesulfonic acid formed. The cheap methanesulfonic acid might, possibly to a limited extent, be used e.g., as a catalyst. An alternative is to pass effluent gas from depletion processes now used through a discharge chamber. The dose then required is probably of the order 20 to 30 krad. (auth)

9914 (TRITA-KKE-7301) REPORT TO THE SWEDISH ATOMIC RESEARCH COUNCIL, 1972. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Kaernkemi). Jan 1973. 130p. (In Swedish and English). Dep. NTIS (U. S. Sales Only) $8.50.

Separate abstracts were prepared for four sections of this report. (LK)

For abstracts of individual sections see: 9915–9918.

9915 (TRITA-KKE-7301, pp vp 12p.) RADIATION INDUCED TRANSIENT ELECTRICAL CONDUCTANCE IN AQUEOUS SOLUTIONS: TECHNIQUE. Appendix 2. Eriksen, T. E. (Royal Inst. of Tech., Stockholm). Jan 1973.

A technique for study of radiation-induced ionic intermediates in aqueous solutions is described. Results are given for the pulse radiolysis of alkaline aqueous sulfite solutions. (SW)

9916 (TRITA-KKE-7301, pp vp 26p.) TITRATION BY ETHYLENE OF THERMAL HYDROGEN ATOMS AND POSITIVE IONS IN CYCLOHEXANE AS STUDIED BY PULSE RADIOLYSIS TECHNIQUE. Reitberger, T.; Niblaeus, K. (Royal Inst. of Tech., Stockholm). Jan 1973.

The dependence of the cyclohexyl radical yield on the concentration of ethylene in cyclohexane was studied. The pulse radiolysis technique was applied to measure directly the yield of cyclohexyl radicals from their optical absorption at 263 nm ($38 \cdot 10^3$ cm^{-1}). The results obtained are $G(H)/G(R) = 0.36$ and $k_{abs}/k_{add} = 4.5 \cdot 10^{-3}$ in good agreement with radical sampling experiments. The consistency of the results also gives credit to the assignment of the optical absorption. As a part of this work an extension of the transient spectrum in pure cyclohexane to 200 nm is also communicated. The spectrum is found to consist of two bands, one peaking at 241 nm and another rising rapidly at 200 nm. The latter is tentatively associated with a charge transfer absorption due to the electron affinity of the cyclohexyl radical. (SW)

9917 (TRITA-KKE-7301, pp vp 26p.) PULSE RADIOLYSIS OF DEOXYGENATED AQUEOUS SOLUTIONS OF SULFUR DIOXIDE: pH EFFECTS. Eriksen, T. E. (Royal Inst. of Tech., Stockholm). Jan 1973.

Optical and conductometric methods were used to study the pulse radiolysis of aqueous solutions of sulfur dioxide–hydrogen sulfite–sulfite. OH· radicals react with SO_2, HSO_3^- and SO_3^{2-} giving the radical ion SO_3^-·. H· radicals abstract hydrogen from HSO_3^- giving SO_3^-· and react with SO_2 to give SO_2^-, which recombine to form $S_2O_4^{2-}$. The rate for the recombination reaction of SO_3^-· radicals was found to be pH dependent in the pH range (5–10). At pH = 10 sulfate is formed, while conductance experiments indicate that at a lower pH a mixture of $S_2O_3^{2-}$ and SO_3^{2-} is formed. The absorption maxima, extinction coefficients, and decay kinetics of the radical ions SO_3^-· and SO_2^-· are given. (SW)

9918 (TRITA-KKE-7301, pp vp 27p.) RADIOLYSIS OF METHYLMERCAPTAN IN DIFFERENT GASEOUS MIXTURES. Appendix 5 and 6. Lind, J.; Bjellqvist, B.; Widen, B.; Eriksen, T. E. (Royal Inst. of Tech., Stockholm). Jan 1973.

Laboratory-scale investigations were made in order to find a method to eliminate odorous methylmercaptan from the craft mill gaseous effluents. Dilute mixtures of mercaptan in different gases were irradiated with ^{60}Co γ radiation. All experiments were run at NTP. The G-values for mercaptan destruction in different gas systems are presented. Different side reactions are discussed. (SW)

9919 ELECTRON PARAMAGNETIC RESONANCE STUDY OF FREE RADICALS IN AN ADAMANTANE MATRIX. VII. Aromatic Hydrogen Addition Radicals. DiGregorio, S.; Yim, M. B.; Wood, D. E. (Univ. of Connecticut, Storrs). J. Amer. Chem. Soc.; 95: No. 25, 8455-8457(12 Dec 1973).

X irradiation of isobutylene in adamantane produced some tert-butyl radical, which suggested that hydrogen atom addition to a precursor molecule could occur. The preparation of hydrogen addition radicals from several aromatic molecules showed that this is a general method of radical formation in adamantane. The details of sample preparation are important in determining whether a hydrogen abstraction radical or a hydrogen addition radical predominates. In x-irradiated degassed samples of adamantane hydrogen addition radical predominates; in non-degassed samples, hydrogen abstraction radical predominates. Adamantane-d_{16} was used to determine isotope effects. (LK)

9920 STRUCTURE OF 2-ALKANONYL RADICALS. III. Electron Paramagnetic Resonance Study of Radicals Produced by X-irradiation of Aliphatic Ketones in Adamantane. Camaioni, D. M.; Walter, H. F.; Jordan, J. E.; Pratt, D. W. (Univ. of Pittsburgh). J. Amer. Chem. Soc.; 95: No. 24, 7978-7992(28 Nov 1973).

A quantitative assessment of the role of spin delocalization in 2-alkanonyl radicals ($RR'\dot{C}COR''$) is provided by the measurement of the ^1H and ^{13}C hyperfine splitting constants (hfs), g values, and optical spectra of 19 radicals of this type (as well as several deuterated species) which are produced by x irradiation of adamantane containing small amounts of the precursor ketones. The ^{17}O hfs of the 2-cyclohexanonyl radical has been determined and the results of INDO calculations on several model compounds are reported. Based on a comparison of the "experimental" π-orbital spin densities with those previously determined for alkyl and allyl free radicals, it is concluded that 2-alkanonyl radicals are approximately 30% allylic in character. Thus, a typical radical of this type is a resonance hybrid of two allylic structures ($RR'\dot{C}COR''$, I, and $RR'C{=}C\dot{O}R''$, II) with structure II contributing about 15%. This conclusion is supported by the observation of effects due to restricted rotation about the $\dot{C}-CO$ bond in the EPR spectra of several open-chain 2-alkanonyl radicals including (1) symmetrically substituted radicals (i.e., R=R′) which exhibit inequivalent α- or β-proton hfs at relatively high temperatures and (2) unsymmetrically substituted radicals (i.e., R ≠ R′) which exist in two conformations of different energy whose relative populations are temperature dependent. An analysis of the spectra of both types of radicals yields estimates of the order of 9 kcal/mol for the barriers to restricted rotation about the $\dot{C}-CO$ bond in symmetrically substituted radicals and makes possible a determination of the structures and relative stabilities of the two conformations of unsymmetrically substituted radicals. Finally, the hfs of some of the β protons in several of the open-chain radicals with γ-alkyl groups are unusually small and show a marked temperature dependence. These results are taken as evidence for an additional barrier hindering rotation about the $C_\alpha-C_\beta$ bond of the radicals and provide information about the structures of the preferred conformations of radicals with intrinsically small rotational barriers. (auth)

9921 ELECTRON SPIN RESONANCE STUDY OF ALLYLIC MONOMER RADICAL FORMATION FROM TETRAMETHYLETHYLENE DIMER RADICAL CATION DUE TO INTRAMOLECULAR PROTON TRANSFER IN γ-IRRADIATED 3-METHYLPENTANE GLASSES. Ichikawa, T.; Ohta, N. (Hiroshima Univ.). J. Amer. Chem. Soc.; 95: No. 24, 8175-8176(28 Nov 1973).

Samples of 3-methylpentane glasses containing small amounts of tetramethylethylene were cooled to 77°K and subjected to ^{60}Co gamma irradiation at a dose rate of 5×10^{17} eV g^{-1} min^{-1}. At high solute concentrations the dimer radical cation $(TME)_2^+$ forms.

At 77°K in the dark the dimer cation changes into the allylic monomer radical, suggesting allyl radical formation through intramolecular proton transfer of the dimer cation. (LK)

9922 RADIOLYSIS OF HYDROGEN SULFIDE IN THE PRESENCE OF HYDROGEN CHLORIDE AND HYDROGEN BROMIDE. Jowko, A.; Szamrej, I.; Forys, M. (University Teachers Coll., Siedlce, Poland). Radiochem. Radioanal. Lett.; 15: No. 6, 353-356(19 Dec 1973).

A small increase in $G(H_2)$ and G(S) has been obtained from the radiolysis of H_2S in presence of HCl. The mechanism was proposed including the ion-molecule reactions of negative ions. (auth)

9923 INFLUENCE OF MOLECULAR MOTIONS ON RADIATION-INDUCED REACTIONS IN POLYMERS. Wuendrich, K. (Federal Inst. for Materials Testing, Berlin). J. Polym. Sci., Polym. Phys. Ed.; 11: No. 7, 1293-1300(Jul 1973).

The degradation of poly(methyl methacrylate) in the temperature range of −196 to 160°C was studied. Two breaks in the Arrhenius plot were found. The first one is located at −5°C and can be correlated with the γ transition, which has been assigned to the hindered rotation of the ester group whose scission initiates the degradation. It is concluded that the thermal excitation of the bond rotation can either increase the scission rate or decrease the recombination rate of reactive intermediates by expanding the cage of the surrounding molecules. If the second mechanism occurs, the rotation of the α-methyl group should also be expected to favor the degradation. However, a second break in the Arrhenius plot was found at −130°C, and therefore significantly above the δ transition. The influence of this motion is therefore not clear. Certain radiation-induced reactions of poly(vinyl chloride), known from literature, seem to be influenced by a secondary transition. It is concluded that secondary transitions may be significant for scission reactions. This suggests, with respect to the known significance of the glass transition, that the various types of molecular motions in polymers may influence radiation-induced reactions. (31 references) (auth)

9924 PROCESS FOR PREPARING OXYMETHYLENE POLYMER. Yoshida, M.; Nakase, Y.; Ito, A. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-560. 4 Jul 1970. 5p. (In Japanese).

A thermostable oxymethylene polymer is obtained in one-stage polymerization of cyclic oligomer of formaldehyde in the presence of carboxylic anhydride as well as thiocyanate ester with multiplication effect thereof without any catalysts. In order to improve polymerization, ultraviolet light and/or ionizing radiation may be used before and/or during polymerization. The radiation dose may be 10^2 to 10^8 rads. In solid-phase polymerization, with the crystal of oligomer such as trioxane and tetraoxane, thiocyanate ester in an amount between 0.01 and 10% by weight and carboxylic acid anhydride in an amount between 0.001 and 15% by weight are either contacted in the form of drops, atomized droplets or gas, or mixed by melting and then solidified after contact with said crystal. In liquid-phase polymerization, either the direct addition to the liquid phase of the oligomer or the liquidizing after contact with the crystal of the oligomer are employed. As in an example, methylthiocyanate, ethylthiocyanate, or benzylthiocyanate together with propionic anhydride or saccinic anhydride were added to 1 g of tetraoxane oligomer and the content was sealed, then were subjected to a dose of 10^4 to 10^6 rads of γ-radiation from a ^{60}Co source at room temperature, subsequently polymerized at 105°C. Melting point of the product obtained was 166 to 172°C. (JA)

9925 PROCESS FOR PREPARING OXYMETHYLENE POLYMER. Nakase, Y.; Yoshida, M.; Ito, A.; Iwai, T.; Hayashi, R. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-200. 4 Apr 1970. 5p. (In Japanese).

Oxymethylene polymer is prepared in a single stage in the absence of any catalyst. The process for preparing the polymer is characterized in that cyclic oligomer of formaldehyde is polymerized by radiation in the presence of thiocyanic acid ester. The radiation may be provided by UV, α, β, γ, x-rays, neutron beams and/or electron beams and carried out either before or after addition of the thiocyanic acid ester to the oligomer with a dose rate of 10^2 to 10^5 rads/hr. Generally, the polymerization is carried out in a sealed tube under a heated condition. The thiocyanic acid ester has a general formula of R-SCN, where R is substituted or unsubstituted aliphatic or aromatic hydrocarbon radical. The ester may be used by 0.01-10% by weight. In examples, 1 gram of tetraoxan purified by sublimation is introduced into a glass ampoule; 3% of ethyl thiocyanate is added, then the ampoule is sealed. It is irradiated by ^{60}Co γ rays to various doses at −78°C. The polymerization system is heated for 4 hr at 105°C. In case of the irradiation of 10^4 rads, the resulting polymer has a polymerization yield of 99% and it shows average thermal decomposition velocity K_{222} of 0.20 (% minute) and viscosity (η) of 2.8. Also, in case of 10^6 rads, polymerization yield: 100%, K_{222} = 0.18 (η) = 2.1. (JA)

9926 PROCESS OF TETRAOXAN POLYMERIZATION. Nakase, Y.; Yoshida, M.; Iwai, T.; Ito, A. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-198. 17 Feb 1970. 3p. (In Japanese).

Tetraoxan is polymerized to 60 to 140°C. in liquid or solid phase and in the presence of radical-producing substances that are peroxide and/or the other compound by high yield. The peroxide is selected from the group consisting of inorganic peroxides such as ozone and hydrogen peroxide; organic peroxides such as benzoyl peroxide, lauroyl peroxide, acetyl peroxide and di-tert-butyl peroxide; and air irradiated by radiation and UV-ray. The compound is a free-radical-producing substance selected from the group, besides the peroxides, consisting of azo-bis-nitriles, azo-compounds, diazo-compounds, nitric esters, nitrous esters, hyponitrous esters, hypohalogenous esters, esters of peracids, sulfides, etc. These radical-producing substances may be added at a concentration between 0.0001 and 10%. The present process is characterized in that the polymerization initiator, which may not polymerize trioxan, polymerizes tetraoxan, and that the polymerization yield may attain to 100% by hydrogen peroxide of cheap radical producing substance, and that the polymerization yield is greatly increased by radiation before the polymerization. In examples, 1 g of tetraoxan mixed with 0.02% of benzoyl peroxide solved in n-hexane is introduced into a glass ampoule. It is polymerized in the water bath for 24 hr at 110°C. The polymer of white crystal is obtained by the yield of 19%. In the case of radiation by ^{60}Co γ rays at a dose of 1×10^5 rads at −78°C before the polymerization, the yield attains to 40%. (JA)

9927 PROCESS OF PREPARING OXYMETHYLENE POLYMER. Nakase, Y.; Ito, A.; Yoshida, M.; Kojima, K.; Iwai, T. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-558. 15 May 1970. 5p. (In Japanese).

Cyclic oligomer of formaldehyde is polymerized in the presence of thiocyanic ester and acetal. It is convenient to irradiate the polymerizing system by ionizing radiations before and/or in the course of the polymerization at a dose of 10^2 to 10^8 rads. The thiocyanic ester has a general formula of R-SCN, where R is a substituted or unsubstituted aliphatic or aromatic hydrocarbon radical. The acetal is cyclic or chain acetal such as methylal, ethylal, and 1,3-dioxane. The thiocyanic ester and the acetal may be added respectively at a concentration between 0.001 to 10% and 0.001 to 15% separately or combinatively. In the case of radiation, the acetal must exist during the polymerization. This process is characterized in that the polymerization yield increases greatly and that the polymer having various molecular weights may be easily obtained by controlling an amount of acetal or the dose of radiation. In an example, 1 g of tetraoxan mixed with 3% methyl thiocyanate and 1.0% methylal is introduced into a glass ampoule. The sealed ampoule is irradiated with ^{60}Co γ rays for 2 hr to a dose of 10^6 rads at −78°C. Polymerization takes place at 105°C. The resulting polymer is a white crystalline powder whose melting point is 166 to 172°C and whose yield is 99%. (JA)

9928 METHOD OF CURING UNSATURATED POLYMER RESIN. Goto, K.; Araki, K.; Sasaki, T. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-556. 18 Jun 1970. 2p. (In Japanese).

An unsaturated polyester resin in contact with a vulcanized rubber is hardened by ionization radiation. The unsaturated polyester resin includes unsaturated dibasic acid such as maleic anhydride and phthalic anhydride, reaction products with dihydric alcohols such as ethylene glycol and propylene glycol, the compounds that can be obtained by dissolving into vinyl monomer such as styrene, vinyl acetate, and methacryiate, the compounds in which parts of unsaturated dibasic acid are substituted by dibasic acid of aliphatic or aromatic compounds, and dibasic acids denatured with compounds having conjugated double bonds. This process can be applied to forming reinforced plastic articles and resinous coatings and to processing vulcanized rubber articles. In an example, an unsaturated polyester resin on the market comprised of propylene glycol maleate fumarate and styrene in amount 33% of the fumarate was coated with a natural rubber sheet including carbon black of 1 mm thick and covered with a cellophane on its surface, then it was irradiated under the room temperature and pressure and 1 mA at a rate of 10 μrad. The resin could be removed from the cellophane and rubber sheet, and hardness of its contacted surface was the same as uncontacted surface. (JA)

9929 METHOD FOR HARDENING UNSATURATED POLYESTER RESIN. Kageyama, T.; Maruyama, T.; Nomaguchi, K.; Sasaki, T.; Araki, K. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-557. 14 Jul 1970. 2p. (In Japanese).

Unsaturated polyester resin is hardened by ionizing radiation after the addition of heterocyclic compounds containing nitrogen

atoms. According to this process, particularly by the addition of the heterocyclic compound, the unsaturated polyester resin may be rapidly, easily, and perfectly hardened by the low dose of 3 to 4 Mrads. The stability of the resulting hardened resin is almost not changed and moreover, the hardening reaction may be stopped at a desirable stage. The following heterocyclic compounds are used at a concentration between 0.05 to 2.0% by weight: six-membered compounds such as pyridine, pyrimidine, triazine, quinoline, phthalazine and pyridazine; five-membered compounds such as pyrroles, imidazole, triazole, and benzotriazole, wherein pyridine is preferable. It is convenient to irradiate the hardening system by, for example, α, β, γ, x rays, electron beams, and heavy proton beams. In the examples, 70 parts of unsaturated polyester (acid value of 45), which is prepared by dehydration condensation of 98 g of maleic anhydride, 148 g of phthalic anhydride and 160 g of propylene glycol, is dissolved in 30 parts of styrene, and 0.1% by weight of pyridine is added to the resulting unsaturated polyester resin. Then the resin of about 200 μ thickness is placed on the surface of glass plate and a cellophane sheet of 30 μ thickness is covered thereon. The laminate is irradiated with electron beams (2 MeV, 1 mA) at a dose of 4 Mrads. It is easily hardened and the surface hardness is 2H of pencil hardness. (JA)

9930 PROCESS FOR PREPARING OXYMETHYLENE POLYMER. Yoshida, M.; Nakase, Y.; Ito, A. (to Japan Atomic Energy Research Inst.). Japanese Patent 1973-559. 20 May 1970. 4p. (In Japanese).

Oxymethylene is polymerized in the presence of thiirane and/or its derivative and organic acid anhydride. It is convenient to irradiate the polymerizing system by ionizing radiations before and/or after addition of thiiranes at the doses of 10^2 to 10^9 rads/hr. Or it is also useful to add thiiranes previously irradiated to the polymerizing system. The thiiranes contain ethylene-, propylene-, 1-butene-, 2-butene-, iso-butene-, trimethylethylene-, cyclopentene-, cyclohexene-, methylenecyclohexene-, 4-methyl cyclohexene-, cycloheptene-, cyclooctene-, styrene-, 3-mercaptopropylene-, 3-chloropropylene sulfide and etc. The organic acid anhydrides contain acetic-, propionic-, butyric-, itaconic-, succinic-, benzoic-, maleic-, phthalic-, malic-anhydride, etc. The thiiranes and the acid anhydrides may be added respectively at a concentration between 10^{-4} to 10% by weight and 10^{-3} to 15% by weight. This process increases the polymerization yield and the resulting polymer has a high thermal stability and any catalyst is not necessary or posttreatment. In an example, 1 g of tetraoxane mixed with 0.05% of ethylene sulfide and 0.01% of propionic anhydride is put into a glass ampoule. After sealing it, the ampoule is irradiated at a dose of 4×10^6 rads of radiation at room temperature. Then polymerization takes place at 110°C for 2 hr. The resulting polymer is white crystalline powder of melting point of 167-174°C whose polymerization yield is 99% and it shows average thermal decomposition velocity K_{222} of 0.15 and viscosity (η) of 1.8. (JA)

9931 SELECTION OF APPROPRIATE DYES FOR THE RADIATION-CHEMICAL PREPARATION OF WOOD–PLASTIC-COMBINATIONS. Proksch, E. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). Allg. Prakt. Chem.; 24: No. 1/2, 14-16(Jan 1973). (In German).

Gamma-radiation experiments on solutions of 38 different dyes in methyl methacrylate and methyl methacrylate/acrylonitrile (70 : 30) gave wide differences in the inhibition effect of the dye on the polymerization of the monomer. In general, methyl methacrylate showed stronger inhibition than the acrylonitrile mixture, which by itself needs higher radiation doses for polymerization than pure methyl methacrylate. Dyes based on organic metal complexes showed on the average on both monomers less inhibition effects than azo, anthrachinone, or basic dyes. The practical application of a series of metal complex dyes for the preparation of colored samples combined of wood and plastics showed good results with one exception, in which the strong adsorption of the dye hindered sufficient coloration of the interior of the sample. (INIS)

9932 RADIOLYSIS OF FOOD ADDITIVES. 1. Radiolysis of Sorbic Acid in Aqueous Solution and Antibacterial Activity of Irradiated Solution. Ishizeki, C. (National Inst. of Hygienic Sciences, Tokyo); Kido, Y.; Urakubo, G.; Sato, K. Eisei Kagaku, 18: No. 5, 337-341(Oct 1972). (In Japanese).

Aqueous solution of sorbic acid (0.32 mg%) was irradiated with ^{60}Co γ radiation (dose rate 2.48×10^4 rad/hr) in doses ranging from 0 to 2.175×10^4 rad, and decomposition of the acid was examined by spectrophotometry. Absorbance at λ max 255nm due to sorbic acid decreased with increasing radiation dose and the G value (–sorbic acid) was calculated from the decreasing rate of the absorbance to give 1.85. An aqueous solution of sorbic acid irradiated at the dose 7×10^5 to 13×10^5 rad showed a stronger antibacterial activity than nonirradiated solution against E. coli, in spite of the decrease of sorbic acid in the solution. Therefore, a new antibacterial substance was assumed to have been produced in the solution by γ irradiation. This irradiated solution also showed antibacterial activity against 5 other kinds of bacteria. It was also proved that the presence of O_2 gas might be essential for the production of the new antibacterial substance by experiments on antibacterial activity of irradiated solutions sealed with or without O_2 gas. (auth)

9933 COPOLYMERIZATION OF STYRENE WITH ISOBUTYL VINYL ETHER BY RADIATION. Hayashi, K.; Hayashi, K.; Okamura, S. (Japan Atomic Energy Research Inst., Osaka). Polym. J.; 4: No. 5, 495-501(May 1973).

In order to elucidate the reason for the considerable difference in the activation energies for the propagation of styrene and isobutyl vinyl ether (IBVE), radioinduced copolymerization of styrene with IBVE was carried out in bulk at 0 and 40°C. The obtained copolymerization ratios are (M_1 = styrene) at 0°C $r_1 = 0.46 \pm 0.05$, $r_2 = 9 \pm 1$ and at 40°C $r_1 = 0.20 \pm 0.06$, $r_2 = 11 \pm 3$. From the temperature dependences of r_1 and r_2, mutual polymerization rate constants, k_{12} and K_{21}, and their activation energies, E_p, were evaluated assuming both k_p and E_p values obtained in bulk polymerizations of styrene and IBVE are constant also in the copolymerization systems studied. It is found that in the reactivity of cation, styrene is greater than IBVE, however, the relation is reversed in relative reactivity of monomer. From the comparison with E_p values in other free cationic polymerization systems, E_p value for IBVE cation is considered to be in some respects extraordinary high, as well as its frequency factor. This is presumably explained in terms of the solvation of IBVE to cation and possibly, resonance stabilization of IBVE cation end. (auth)

9934 COMPOSITIONS FOR RADIATION HARDENING. Hayashi, M.; Fujii, S. (to Dai Nippon Toryo Co. Ltd.). Japanese Patent 1973-2421. 29 May 1969. 4p. (In Japanese).

A monomer solution of epoxy resin ester is hardened by ionizing radiation. The process for preparing the compositions for radiation hardening consists of resolving the epoxy resin ester, which is obtained by addition reaction of epoxy resin (epoxy equivalent of 70–4000, hydroxyl group value below 10 milimole/gram, molecular weight of 140–5000) and unsaturated dibasic acid or semi-ester into one or more monomers such as acrylic acid ester or methacrylic acid ester of amino alcohol, tetrahydrofurfuryl alcohol, and methyl alcohol and/or such as vinyl pyridine or vinyl pyrrolidone. The concentration of the resin is 10 to 90% by weight. Dose rate preferred for the process is 0.5 to 20 megarads. In the examples, 100 parts of the epoxy novoluk resin are esterified by addition of 39.6 parts of monoethyl maleic acid. The tetrahydrofurfuryl methacrylate monomer solution of this ester is hermetically received into a test tube of hard glass. Then the sealed tube is irradiated by ^{60}Co γ rays for 10 hr at a dose or 10×10^5 rads/hr that corresponds to 1 megarad. The gel value of the irradiated sample is 83.3%. (JA)

9935 FORMATION OF THYMINE FROM THYMINE GLYCOL BY GAMMA-IRRADIATION IN AN AQUEOUS SYSTEM. Hayashi, T.; Namiki, M. (Nagoya Univ., Japan). Agr. Biol. Chem. (Tokyo); 36: No. 4, 551-557(Apr 1972).

When an aqueous solution of thymine glycol, a main radiolysis product from thymine, was γ-irradiated in the absence of oxygen, a characteristic uv absorption, which was absent before irradiation, was found to be developed. From the chromatographical and spectrophotometrical investigations and microbiological assay, one of the main uv positive products was identified to be thymine. The initial G values with 2 mM thymine glycol solution were 1.1 and 0.4 for thymine glycol decomposition and thymine formation, respectively. The formation was suppressed by the presence of oxygen or nitrous oxide, while it was enhanced by potassium thiocyanate or sodium formate. Thus, the presence of a new reversible reaction between thymine and thymine glycol through radiolysis in an aqueous system was proposed. (auth)

9936 RADIOLYSIS OF ETHYLENE + ETHANOL SYSTEMS. II. Telomerization Reactions at High Pressures. Basson, R. A.; Van Wyk, L. (Atomic Energy Board, Pretoria). J. Chem. Soc., Faraday Trans., I; 69: No. 11, 1945-1952(1973).

The radiolysis products of the ethylene + ethanol system, at high pressures, have been determined. The effects of ethylene pressure and dose rate were examined. The results obtained previously [Basson et al., J. Chem. Soc.; 809 (1970)] have been analyzed using a general kinetic expression. Possible reasons for the formation of polymer at low dose rates and high ethylene pressures are discussed. (auth)

9937 EFFECTS OF γ RAYS ON POLY-L-GLUTAMIC ACID IN AQUEOUS SOLUTIONS. Kunikane, M.; Sugai, S. (Hokkaido Univ., Sapporo). Biophysik; 10: No. 3, 221-228(Oct 1973).

Salt-free and 0.2 M NaCl oxygenated aqueous solutions of poly-L-glutamic acid were irradiated with ^{60}Co γ radiation at various

pH's to examine whether or not the changes caused by the exposure to ionizing radiation depend on pH, that is, the conformations of polypeptide. The G-values (the number of main-chain scissions per 100 eV of energy absorbed) in both salt-free and 0.2 M NaCl solutions of poly-L-glutamic acid were found to change sharply with pH and to have a maximum value at the pH of a mid-point of helix-coil transition. The change of G-values with pH was discussed in terms of the conformational change of poly-L-glutamic acid. (GE)

9938 γ RADIOLYSIS OF THE WATER VAPOR–AMMONIA–OXYGEN SYSTEM. Randrianarivo, P. (Conservatoire National des Arts et Metiers, Paris); Epherre, P.; Roth, E.; Rozenberg, J. Radiochim. Acta; 18: No. 4, 178-180(1973). (In French).

The γ radiolysis of the water vapor–NH_3 system is greatly dependent on oxygen concentration. In the absence of oxygen, $G(H_2)/G(N_2)$ ratio is always three, showing a radiolytic decomposition of ammonia into its constituents. When oxygen is added, $G(-O_2)$, $G(N_2)$ and $G(H_2)$ become independent of oxygen concentration and of NH_3 concentrations at values larger than 0.1 mole % NH_3 in water vapor. The disappearance mechanism of oxygen is complex. It is assigned for 80%, to a recombining reaction into water vapor. Small yields of NO_2 and N_2O are also found. After the added oxygen is consumed, the $G(H_2)/G(N_2)$ ratio of three is observed and total yields increase. (GE)

9939 γ-RADIOLYSIS AND β-AUTORADIOLYSIS OF AQUEOUS SOLUTIONS OF THYMIDINE AND URIDINE. Kopoldova, J.; Dedkova, V. (Czechoslovakia Akademie Ved, Prague). J. Label. Compounds; 9: No. 3, 509-520(1973).

The effect of external γ- and internal β-irradiation on the aqueous solutions of unlabelled and ^3H-labelled preparations of thymidine and uridine was investigated within the concentration range $10^{-4} - 2 \times 10^{-2}$ M. From these investigations corresponding D/50 and $G_1(-M)$ values were calculated and compared. The differences between the $G_1(-M)$ values of labelled and unlabelled preparations obtained in very dilute solutions (up to $5 \times 10^{-3} - 10^{-2}$ M) were discussed. (auth)

9940 THEORETICAL CONSIDERATION OF THE ELECTRON SCAVENGING PROCESS IN LIQUID HYDROCARBONS. 4. Integral Transforms in the Prescribed Diffusion Approximation. Yamazaki, H.; Shinsaka, K. (Tokyo Inst. of Tech.). Bull. Chem. Soc. Jap.; 46: No. 9, 2642-2646(Sep 1973).

The relations of the integral transforms and the integral form between various distributions functions are discussed in the prescribed diffusion approximation for the Smoluchowski equation. The initial electron distribution from the central-ion cluster in a spur or a track, $\omega(r, O)$; the time dependence of the central value of the electron distribution, $\omega(O, t)$; the time dependence of the space-averaged electron concentration, $N(t)$, after pulse irradiation, and the scavenger-concentration dependence of the relative G-value of electron scavenging, $G_s(k_sC_s)$, as a function of the scavenger concentration, C_s, and the rate constant, k_s, are shown to be connected by this diagram of the Laplace transforms and the integral form:

$$\begin{array}{ccc} \omega(O, t) & \xrightarrow{\text{Laplace transform}} & \omega(r, O) \\ \text{Integral form} \downarrow & & \\ N(t) & \xrightarrow{\text{Laplace transform}} & G_s(k_sC_s) \end{array}$$

By the use of this relation, the various distribution functions are evaluated from the generalized Gaussian initial distribution. The square-root relationship of the $G_s(k_sC_s)$ to the scavenger concentration is discussed. (auth)

9941 ESR OF THE RADICAL-ION CO_3^- IN γ-IRRADIATED POTASSIUM BICARBONATE. Top, Z. H. (Weizmann Inst. of Science, Rehovoth, Israel); Raziel, S.; Luz, Z.; Silver, B. L. J. Magn. Resonance; 12: No. 2, 102-108(Nov 1973).

Electron spin resonance measurements are reported of the radical-ion CO_3^- in ^{17}O-labeled single crystals of potassium bicarbonate. Three sextets of ^{17}O-satellites due to three inequivalent oxygen nuclei are observed. The hyperfine splitting of one oxygen nucleus is small at all orientations of the magnetic field. The other two are highly anisotropic and approximately cylindrically symmetric. Analysis of these results shows that the unpaired electron is predominantly distributed over two in-plane oxygen 2p-atomic orbitals on two oxygen atoms. The results support theoretical predictions that the stable configuration of the CO_3^- radical is Y-shaped with C_{2v} symmetry. In the $KHCO_3$ host crystal, crystallographic interactions further reduce the symmetry of the radical. (auth)

9942 AN ESR STUDY OF FREE-RADICAL CONVERSIONS IN IRRADIATED SINGLE CRYSTALS OF N-ACETYLGLYCINE IN THE TEMPERATURE RANGE 77-300°K. Saxeboel, G. (Univ., Oslo). Int. J. Radiat. Biol.; 24: No. 5, 475-485(Nov 1973).

The radical products formed in single crystals of N-acetylglycine have been studied with ESR spectroscopy. Altogether five radicals are formed in the temperature range 77 to 300°K. Two of the intermediate radicals, $H_3C{\cdot}CO{\cdot}NH{\cdot}CH_2{\cdot}COOH$ and $H_3C{\cdot}CO{\cdot}N{\cdot}CH_2{\cdot}COOH$ were identified in this work. The first is formed via a first-order process with an activation energy of 15.4 kcal/mole. Both intermediates are precursors of the same secondary radical previously identified by Miyagawa, Kurita, and Gordy [J. Chem. Phys. 33, 1599 (1960)]. The results yield a reaction scheme for N-acetylglycine very much in agreement with that proposed for amino acids. (auth)

9943 ELECTRON SOLVATION PROCESSES IN ALCOHOL-HYDROCARBON MIXTURES. Brown, B. J. (Univ. of New South Wales, Kensington, Australia); Barker, N. T.; Sangster, D. F. Aust. J. Chem.; 26: No. 10, 2089-2099(Oct 1973).

The solvated electron has been investigated in mixtures of polar and non-polar liquids (methanol, ethanol, propanol, and isopropyl alcohol respectively in hexane) by pulse-radiolysis. The respective yields and transition energies of the electron in the mixtures do not show the same dielectric dependence as has been established for pure liquids. The relative number of electrons escaping geminate recombination increases with an increase in the alcohol concentration, but the mechanisms of optical transition and electron decay remain unchanged. Infrared spectroscopic studies have shown that electron stabilization is related to the existence of quasi-stable associated alcohol complexes. For ethanol, an observed decrease in the solvated free electron yield with an increase in temperature is in accord with a shift in associative equilibrium. (auth)

9944 POLYMERIZATION OF VINYL CHLORIDE IN THE PRESENCE OF PRECIPITANTS. I. Arita, K.; Stannett, V. (North Carolina State Univ., Raleigh). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 7, 1565-1588(Jul 1973).

The kinetics of bulk and precipitation polymerization of vinyl chloride was studied over wide range of reaction temperature by using γ-induced initiation. The autoacceleration effect, which has been observed by many investigators in the case of chemically initiated bulk polymerization of vinyl chloride above 40°C and has been the most controversial aspect of the bulk polymerization of vinyl chloride, was found to disappear in the bulk polymerization below 0°C. In the bulk polymerization at 40°C, the autoacceleration effect was observed up to 20%, in agreement with the results of previous investigators, and a pronounced effect of the size of polymer particles on the time-conversion curve was observed. The kinetics of precipitation polymerization of vinyl chloride in the presence of some nonsolvents was successfully described by a one-parameter equation. A kinetic scheme, which clearly explains the zero-order reaction behavior of bulk polymerization at low temperature and the kinetic behavior of precipitation polymerization described by the empirical equation, is proposed. The autoacceleration effect in the bulk polymerization at 40°C was considered to be essentially the same phenomenon as the small retardation period observed in the bulk polymerization at low temperature. (auth)

9945 STEADY-STATE APPROACH TO KINETICS OF RADICAL POLYMERIZATION OF VINYL CHLORIDE: A REINTERPRETATION. Arita, K.; Russo, S.; Stannett, V. (North Carolina State Univ., Raleigh). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 7, 1757-1758(Jul 1973).

Previously reported studies on the kinetics of the radioinduced polymerization of vinyl chloride have been reexamined. It is pointed out that the reaction scheme on which the steady-state approach was based has certain limitations which cannot be resolved when applied to the radioinduced bulk polymerization of prepolymerized polymer–monomer mixtures, in which the polymer particle size shows a marked effect. (JGB)

9946 VISCOSITY STUDY OF RADIATION CHEMISTRY OF POLYSTYRENE. Chau, T. C.; Rudin, A. (Univ. of Waterloo, Ont.). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 10, 2591-2600 (Oct 1973).

The effects of γ-radiation on aqueous polystyrene emulsions were followed by measurements by intrinsic viscosities of soluble polymer in toluene. Estimates of incipient gel dose from intrinsic viscosity data do not coincide closely with those from measurements of gel content. This uncertainty and those in molecular weight averages make it difficult to assign a precise value to G(crosslink), even when the scission/crosslinking ratio in the particular system is reliably known. The intrinsic viscosity of sol polymer in the postgel region decreases with increasing dose to an asymptotic value. The decrease is as expected if larger molecules are progressively linked into the gel network and the asymptote may be attributable to cyclization. Present theories of branching do not seem to be applicable for quantitative estimation of scission/cross-

linking ratios caused by irradiation of polystyrene. This is probably connected with deficiencies in the theoretical connection between radius of gyration and intrinsic viscosity in good solvents. Diallyl fumarate and diallyl maleate increased crosslinking rates, but only at low doses. Chain scission was enhanced by addition of 1,2-dichloroethylene and 2,5-dimethylhexane-2,5-dihydroperoxide. (auth)

9947 ADSORPTION OF POLYMERS AT THE SOLUTION-SOLID INTERFACE. X. Reinforcement Studies of Nitrile Rubbers by Silicas. Clark, P. J.; Howard, G. J. (Univ. of Manchester, Eng.). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 10, 2437-2449 (Oct 1973).

Vulcanizates of three acrylonitrile-butadiene copolymers were prepared by γ-ray irradiation. Two pyrogenic silicas of differing surface areas and with surface modifications were incorporated as fillers. Measurements of initial modulus, stress-strain hysteresis, tear energy, and swelling show little differences between the reinforcement effects of the various fillers, although the extent of filler reinforcement is related to the acrylonitrile content of the rubber. The considerable range of interaction energies implied by solution adsorption studies are not reflected in the reinforcement phenomena. (auth)

9948 RADIATION-INDUCED COPOLYMERIZATION OF ISOBUTYL VINYL ETHER WITH TRICHLOROETHYLENE. du Plessis, T. A.; Thomas, A. C. (Atomic Energy Board, Pretoria). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 10, 2681-2690(Oct 1973).

The radiation-induced copolymerization of isobutyl vinyl ether with trichloroethylene was investigated in the temperature range from −50°C to 100°C over a wide range of comonomer compositions. A copolymer was obtained in which the monomers alternate with regularity along the polymer chain over essentially the entire range of comonomer compositions. Both the rate of copolymerization and the number-average molecular weight of the resulting copolymer were found to depend strongly on the initial comonomer composition. The monomer reactivity ratios were determined and correspond well with calculated values. An apparent activation energy of 3.2 kcal/mole was obtained for the copolymerization process which exhibits a dose rate dependence of 0.72. The number-average molecular weight was found to be strongly dependent on the irradiation temperature, reaching a maximum value at 5°C. (auth)

9949 KINETICS OF RADIATION-INDUCED GRAFTING REACTIONS. II. Cellulose Acetate−Styrene Systems. Yasukawa, T.; Sasaki, Y.; Murakami, K. (Tohoku Univ., Sendai). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 10, 2547-2556(Oct 1973).

Kinetics of grafting reactions of styrene to preirradiated cellulose acetate have been studied by labeling the active sites with bromine atoms. The dilution of styrene monomer with methanol affected grafting reactions remarkedly: e.g., as the concentration of methanol in monomer solutions increased, the growth rates of individual graft radicals decreased while the average lifetimes increased. The integrated amounts of active sites which participated in grafting reactions were also affected by the constitution of monomer solutions and varied roughly in proportion to the extents of swelling of cellulose acetate. Grafting yields for styrene/methanol = $^1/_1$ were higher than for $^3/_1$ and $^1/_3$ throughout the duration of grafting reactions, which is due not only to the high molecular weight of graft chains but also to the large number of graft chains for the $^1/_1$ system compared to the other systems. (auth)

9950 RADIATION-INDUCED POLYMERIZATION OF GLASS FORMING SYSTEMS. VI. Polymerization Rate at Higher Conversion in Binary Systems. Kaetsu, I.; Ito, A.; Hayashi, K. (Japan Atomic Energy Research Inst., Takasaki). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 8, 1811-1818(Aug 1973).

The effect of temperature and composition on the inflection point in the time-conversion curve and the saturated conversion was investigated in the γ-radio-induced radical polymerization of binary systems consisting of a glass-forming monomer and a solvent. In the polymerization of completely homogeneous systems such as glycidyl methacrylate (GMA)−triacetin and hydroxyethyl methacrylate (HEMA)−propylene glycol systems, the time-conversion curve has an inflection point at polymerization temperatures between T_{vm} (T_v of monomer system) and T_{vp} (T_v of polymer system). Such conversions at the inflection point changed monotonically between 0 and 100% in this temperature range. T_v was found to be 30 to 50°C higher than T_g (glass transition temperature) and a monotonic function of composition (monomer−polymer−solvent). The acceleration effect continued to 100% conversion above T_{vp}, and no acceleration effect was observed below T_{vm}. The saturated conversion in homogeneous systems changed monotonically between 0 and 100% for polymerization temperatures between T_{gm} (T_g of monomer system) and T_{gp} (T_g of polymer system). T_g was also a monotonic function of composition. No saturation in conversion was observed above T_{gp}, and no polymerization occurred below T_{gm}. In the polymerization of completely heterogeneous systems such as HEMA−dioctyl phthalate, no acceleration effect was observed at any temperature and composition. The saturated conversion was 100% above T_g of pure HEMA, and no polymerization occurred below this temperature in this system. (auth)

9951 RADIATION-INDUCED POLYMERIZATION AT HIGH PRESSURE OF CIS- AND TRANS-1,3,3,3-TETRAFLUOROPROPENE IN BULK AND WITH TETRAFLUOROETHYLENE. Brown, D. W.; Lowry, R. E.; Wall, L. A. (National Bureau of Standards, Washington, DC). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 8, 1973-1984(Aug 1973).

The γ-radio-induced polymerization of cis- and trans-1,3,3,3-tetrafluoropropene in bulk and with tetrafluoroethylene was studied at pressures between 5000 and 15,000 atm and temperatures between 21 and 100°C. At 10^3 rad/hr the homopolymerization rates range from about 10^{-4} to 1%/hr. The activation enthalpy and volume are about 8 kcal/mole (33 kJ/mole) and −10 cm^3/mole, respectively, for both isomers. The cis isomer polymerizes about twice as rapidly as the trans isomer. The latter freezes in the experimental range of temperature and pressure; the polymerization rate is very low in solid phase. Polymer intrinsic viscosities increase with polymerization pressure and decrease with polymerization temperature; the largest value obtained was 0.23 dl/g. In the copolymerizations all reactivity ratios favor incorporation of tetrafluoroethylene by factors of 6 to 16. The preference is stronger when the trans isomer is used. (auth)

9952 ANION RADICALS OF ACRYLIC MONOMERS IN γ-IRRADIATED ORGANIC GLASSES AT 77°K. Gillbro, T. (Swedish Research Councils's Lab., Nykoeping, Sweden). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 5, 309-312(May 1973).

Electron spin resonance studies on methyl methacrylate, methyl acrylate, ethyl acrylate, allyl methacrylate, acrolein, acrylamide, acrylic acid, crotonic acid, and methyl crotonate are reported. Acrylic monomers gamma irradiated in the dark at 77°K in dried organic glasses give rise to ESR spectra that are easily photobleached. Study of these spectra suggests that anion radicals are formed from the acrylics in gamma-irradiated glasses of 2-methyltetrahydrofuran, 3-methylpentane, and 3-methylhexane. (LK)

9953 ANALYSIS OF THE ESR SPECTRA OF ORIENTED POLYAMIDE 6. Tino, J.; Szocs, F. (Polymer Inst., Bratislava). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 5, 323-326(May 1973).

Results of the analysis of ESR spectra of the radicals trapped in gamma-irradiated oriented polyamide 6 are presented. Experimental and theoretical spectra are compared. (LK)

9954 SOLVENT EFFECT ON THE RADIOCHEMICAL COPOLYMERIZATION OF ACRYLAMIDE WITH ACRYLONITRILE. Perec, L. (CNRS, Meudon, France). J. Polym. Sci., Polym. Lett. Ed.; 11: No. 4, 267-270(Apr 1973).

Copolymerization of acrylamide with acrylonitrile by gamma radiation in water, acetic acid, methanol, dimethylformamide, acetonitrile, and dioxane, which might modify the degree of association present in the system were studied. The observed solvent effect might be due to modification of the association of acrylamide with itself or with the solvent. In solvents where the plurimolecular association of acrylamide is not destroyed, the rate of propagation might be modified due to the large local concentration of the monomer. (LK)

9955 POLYMERIZATION OF VINYL CHLORIDE IN THE PRESENCE OF PRECIPITANTS. II. Arita, K.; Stannett, V. T. (North Carolina State Univ., Raleigh). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 9, 2127-2142(Sep 1973).

The kinetics of the radiation-induced polymerization of vinyl chloride in the presence of precipitants has been successfully described by a one-parameter equation as follows, $\phi_0 X - (1 - \phi_0)$ $\ln (1 - X) = kt$ where ϕ_0 is initial monomer volume fraction, X is conversion, t is time, and k is reaction constant. The equation was confirmed for extensive conditions of temperatures and monomer concentrations in the case of polymerization in methanol. The degree of polymerization was related with the reaction constant k, initial monomer volume fraction ϕ_0, monomer chain transfer constant C_m, conversion X, and the initiation rate I as follows, $1/\overline{DP}_n = C_m + (1/2)(1/k)\,(1/[M]_0 X)\,[\phi_0 X - (1 - \phi_0)\ln(1 - X)]$. The factors which determine the value of the reaction constant k were elucidated through reaction constant k and the degree of polymerization $\overline{DP}_n$. (auth)

9956 RADIATION-INDUCED POLYMERIZATION OF CYCLOHEXENE SULFIDE IN THE SOLID STATE. Hiramoto, T. (Japan Atomic Energy Research Inst., Osaka); Nishii, M.; Fiala, V.; Yamaoka, H. J. Polymer Sci., Polym. Chem. Ed.; 11: No. 9, 2257-2263(Sep 1973).

Radiation-induced solid-state polymerization of cyclohexene

sulfide has been investigated. Differential thermal analysis shows that this compound has a phase transition point at −74°C and behaves as a plastic crystal in the temperature range from −74 to −20°C (melting point). By rapid cooling, this plastic crystal was easily supercooled, and below −166°C a glassy crystal, i.e., a supercooled nonequilibrium state of plastic crystal, was obtained. In-source polymerization proceeded in the plastic crystalline state. Postpolymerization of glassy crystalline monomer irradiated at −196°C occurred above −166°C (glass transition point) during subsequent heating. (auth)

9957 CHEMICAL STRUCTURE OF POLY(ETHYLENE TEREPHTHALATE)-STYRENE AND NYLON-STYRENE GRAFT COPOLYMERS PREPARED BY RADIATION TECHNIQUES. Sakurada, I.; Ikada, Y.; Kawahara, T. (Kyoto Univ.). J. Polymer Sci., Poly. Chem. Ed.; 11: No. 9, 2329-2342(Sep 1973).

The graft copolymerizations of styrene onto poly(ethylene terephthalate) (PET) and nylon fibers were carried out by the mutual irradiation and preirradiation methods. True graft copolymers were isolated from the products by extraction and characterized by hydrolysis and osmometry. Among the swelling agents employed, methanol was most effective for increasing the extent of grafting onto PET. In both methods of the grafting, the molecular weight of polystyrene formed in the substrate matrix was higher than one million if no chain-transfer agent was added to the monomer solution. Similar to the case of radiation grafting onto poly(vinyl alcohol) and cellulose, the isolated graft copolymer carried only one branch per copolymer molecule in both cases. Of great interest is the particularly low extent of grafting in the case of PET-styrene. This should be attributed to the low sensitivity of PET to radiation. The grafting site on the mother polymer molecule is discussed on the basis of the solution behavior of the branch polymers separated from the backbone. (auth)

9958 VINYL ACETATE EMULSION POLYMERIZATION. I. Effect of Ionic Strength and Temperature on Monomer Solubility in the Ionically Stabilized Polymer Particle. Klein, A. (National Starch and Chemical Corp., Plainfield, NJ); Kuist, C. H.; Stannett, V. T. J. Polymer Sci., Polym. Chem. Ed.; 11: No. 9, 2111-2126 (Sep 1973).

Solubility of monomer in the γ-induced polymer was strongly affected by ionic strength; with increasing ionic strength, solubility was found to increase. At constant temperature, this was entirely due to the decrease in interfacial tension, as the condensation of surfactant proceeded at the interface. The temperature affected both the polymer–solvent interaction parameter as well as the interfacial tension. These are the two parameters on which solubility depends. The variations of interfacial tension with temperature was found to be complex, but entirely dependent on the entropic consideration of adsorption. The polymer–solvent interaction parameter–inverse temperature dependence was found to be linear, as expected. (auth)

9959 ESR STUDIES ON GAMMA-IRRADIATED TAN (TRIACETONEAMINE N-OXYL) RADICALS. Mishra, K. P.; Singh, B. B.; Gopal-Ayengar, A. R. (Bhabha Atomic Research Centre, Bombay). Int. J. Radiat. Biol.; 24: No. 4, 417-420(Oct 1973).

A study has been made of the effect of O_2 on the ESR spectra observed with aqueous solutions of TAN (10^{-3} M). In experiments with unirradiated solutions the total number of spins calculated from the line width measurements as well as numerical integration of the absorption curve was 65 ± 2% in the oxygenated, compared with 100% in the deoxygenated sample. The ESR signal could, however, be recovered on bubbling nitrogen gas through the solution. It is suggested that, in addition to enhancing the line width of the signal, oxygen interacts with TAN, forming an oxygen bridge and destroying its free radical character. On γ-irradiation the ESR signal of TAN decreased in intensity, without change in the line width, the destruction of TAN being more efficient in anaerobic [G(-TAN) = 1.97] than in aerobic conditions [G(-TAN) = 0.76]. The ESR signal of TAN reappeared on exposing the irradiated solution to air. It is inferred that some transients from water radiolysis reacted with TAN, making a relatively long-lived nonparamagnetic product which could be reconverted to TAN, possibly after interacting with oxygen. It is suggested that one of the probable transients is the hydrated electron, and that the long life of TAN anion and its ability to transfer the electron to other molecules of biological significance might be of importance in radiosensitization. (UK)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 11168.

Hot-Atom Chemistry

9960 (BMFT-FBK-73-22, pp 44-49) FAST REACTIONS IN THE GAS PHASE. Rudolph, W. Aug 1973. (In German). In annual report, 1972.

9961 (BMFT-FBK-73-22, pp 49-55) REACTIONS OF HOT HALOGEN ATOMS WITH ETHYLENE. Kobayashi, M. (Kyoto Univ.); Denschlag, H. O. Aug 1973. (In German). In annual report, 1972.

9962 (COO-2190-11) DYNAMICS AND MECHANISMS OF HOT CHEMISTRY STIMULATED BY RECOIL METHODS (GAS PHASE STUDIES OF THE KINETICS AND MECHANISM OF HIGH ENERGY SULFUR ATOM REACTIONS AND SOME NOVEL ASPECTS OF HOT HALOGEN REACTIONS). Progress Report, March 1, 1973–February 28, 1974. Spicer, L. D. (Utah Univ., Salt Lake City (USA)). 1973. Contract AT(11-1)-2190. 17p. Dep. NTIS $3.00.

Research progress is reported on the inelastic energy transfer properties of highly excited molecules, studies of recoil sulfur reactions with hydrogen gas, and the technique used to study recoil chlorine reactions with hydrogen gas. (DHM)

9963 ENHANCED YIELDS OF LABELED ETHYLENE FROM THE REACTION OF RECOIL TRITIUM WITH ETHANE. Urch, D. S. (Queen Mary Coll., London). Radiochim. Acta; 18: No. 4, 176-180(1973).

Cipollini and Stoecklin have reported that the relative yield of labeled ethylene from the reaction of recoil tritium atoms with ethane is increased by a factor of ten by the addition of methyl chloride. This remarkable result is explained by proposing that a collision complex is formed between methyl chloride and an excited labelled ethane molecule. Unimolecular decomposition $C_2H_5T \rightarrow C_2H_3T + H_2$ is via a high activation energy route in which four orbitals interact in phase in a cyclic manner. The addition of methyl chloride permits the in-phase cyclic interaction of six orbitals which is associated with a lower activation energy. Data from the system ethane–butane is also examined to see if similar transitory complexes could be formed between these molecules, again leading to enhanced ethylene-t formation from ethane. (GE)

9964 REACTIONS OF RECOIL CHLORINE. II. CHEMICAL EFFECTS OF $^{37}Cl(n,\gamma)^{38}Cl$ IN BINARY MIXTURES OF CARBON TETRACHLORIDE WITH PARAFFINS AND ALCOHOLS. Kontis, S. S. (Democritus Nuclear Research Centre, Athens); Urch, D.S. Radiochim. Acta; 18: No. 4, 173-175(1973).

The reactions of recoil chlorine $^{37}C(n,\gamma)^{38}Cl$ in binary mixtures of carbon tetrachloride with n-hexane, cyclohexane, n-heptane, methanol, ethanol, and n-octanol were studied. The results are compared with those from similar mixtures in which chlorobenzene was used as a source of chlorine. No evidence was found for a dependence of chemical properties of the recoil atom upon the source molecule. Some discrepancies with previous results were observed which may be due to differences in radiation dose or experimental technique. (GE)

9965 EFFECT OF TEMPERATURE CHANGE ON ^{80m}Br DECAY IN BROMOETHANE. Da Fonseca, A. J. R.; Shaw, P. F. D. Radiochim. Acta; 18: No. 4, 159-167(1973).

Analyses of the products from the decay ^{80m}Br conbined initially as bromine or bromoethane were made in bromoethane–bromine mixtures at −80°C, and compared with those found at room temperature. The changes caused by reducing the temperature are generally compatible with the reduced diffusion which leads to greater scavenger insensitive yields. Yields derived from labile radicals are particularly susceptible to change of temperature and compatible with the occurrence of thermal spikes in the system. Analysis of the Auger electron cascade following internal conversion confirms that thermal spikes are feasible. (GE)

9966 ACCURACY OF HOT ATOM KINETIC THEORY PARAMETERS. Carlson, R.; Freedmen, A.; Press, G. A.; Malcolme-Lawes, D. J. (Yale Univ., New Haven). Radiochim. Acta; 18: No. 4, 167-173(1973).

A computer model is used to simulate the basic model of the kinetic theory of hot atom reactions using a variety of energy loss distribution functions. It is found that the actual distribution of energy losses has little effect on the derived kinetic parameters, although in many cases derived individual product parameters are a poor reflection of their defined values. (GE)

9967 CHEMICAL EFFECTS OF OSMIUM NEUTRON CAPTURE RECOILS. 3. Cation Effect in Crystalline Mixtures of $K_4Os(CN)_6$–$K_4Fe(CN)_6$–$Cs_4Fe(CN)_6$. Diefallah, E. M. (Assiut Univ., Egypt); Kay, J. G. Bull. Chem. Soc. Jap.; 46: No. 10, 3318-3319(Oct 1973).

Osmium recoil effects were studied in crystalline mixtures of

the type $K_4Os(CN)_6-K_4Fe(CN)_6-Cs_4Fe(CN)_6$ in order to investigate the role of the cation in diluted systems. Neutron irradiations were carried out at a thermal neutron flux of 1.8×10^{12} n/cm²/s, fast neutron flux of 1.8×10^{12} n/cm²/s, and gamma ray dose rate of about 1.4×10^7 rad/hr. The potassium–cesium salt mixtures were each irradiated for 6.0 hr and then analyzed by paper electrophoresis. Tabulated results of cyanoosmate(II) parent retention determined as a function of $Cs_4Fe(CN)_6$ mole fraction in the cesium–potassium crystalline mixtures indicate that replacement of cesium for potassium causes a large decrease in parent retention. In general, the probability of parent reformation is not only determined by the density of lattice defects and radiation damage in the crystal, but also by the energy of activation for release from traps. It is expected that the more ionic cesium salt with a larger band gap would increase the trap depth and activation energy for reactions giving rise to initial retention. (JGB)

Properties of Radioactive Materials

Refer also to abstracts 9861, 9893, 9906, 10498, 10612, 10613, and 10793.

9968 (JINR-E12-7547) STUDIES OF THE HEAVIEST ELEMENTS AT DUBNA. Zvara, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 28p. (CONF-730927-4). Dep. NTIS (U.S. Sales Only) $3.50.

From 24th congress of the International Union of Pure and Applied Chemistry; Hamburg, F.R. Germany (3 Sep 1973).

Recent works of several Dubna groups on the transactinide and superheavy elements are reviewed. New experiments on the volatility properties of kurchatovium and nielsbohrium halides were performed. Some fast techniques, based on gas thermochromatography of volatile inorganic species, were developed for the chemical identification of elements beyond 105 as well as for the superheavy elements. Using germanium and xenon ion beams, available for the first time, the yields of various activities produced in the bombardment of uranium and other targets were measured to elucidate the interaction patterns of these extremely heavy bombarding particles. Superheavy elements were looked for in the reaction products. (auth)

9969 (ORO-1797-45) KINETICS OF EXCHANGE OF TRIVALENT ACTINIDE IONS WITH EUROPIUM ETHYLENEDIAMINETETRAACETATE. Williams, K. R.; Choppin, G. R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1973. 15p. Dep. NTIS $3.00.

The kinetics of exchange has been studied for Cm(III), Bk(III), and Cf(III) with $EuEDTA^-$ in an aqueous solution of 0.1 M total ionic strength with acetate buffer. The kinetic equation involves both acid dependent and acid independent terms. Mechanisms for both paths are proposed. (LK)

9970 INFLUENCE OF CONTAMINANTS ON THE DECONTAMINATION PROPERTIES OF PLASTICS. Otto, R.; Boetius, I. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 9, 323-324(Sep 1973). (In German).

The results of the investigation of plastics decontamination with respect to several contaminating radionuclides (^{58}Co, $^{89}Sr/^{90}Y$, $^{144}Ce/^{144}Pr$, $^{95}Zr/^{95}Nb$, and primary-circuit water of a pressurized-water reactor) are reported. Decontamination is performed using an aqueous solution containing detergents and complexing agents. The experiments are evaluated through direct and rubbing-test measurement to plot an order for the radionuclides according to the decontamination difficulty. (auth)

9971 SECONDARY-ELECTRON EMISSION FROM RADIOACTIVE PRECIPITATES. Bobykin, B. V.; Lyubov, S. K.; Nevinnyi, Yu. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2912-2913(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3448-3450(Nov 1972).

An electrode system was used to accelerate the electrons emitted from a radioactive precipitate, which were then studied in a β-ray spectrometer. The emission spectrum of $^{57}CoCl_2$ precipitate showed that all of the electrons left the precipitate with energies not exceeding 1 eV. Other radioactive precipitates also emitted a large number of slow secondary electrons. (DLC)

9972 IMPROVED METHODS FOR PREPARATION OF ^{32}P-LABELLED ORGANO-PHOSPHORUS INSECTICIDES AND PRECURSORS. Dedek, W.; Grahl, R. (Forschungsstelle fuer Chemische Toxikologie, Leipzig). Isotopenpraxis; 9: No. 9, 309-312(Sep 1973). (In German).

Starting from unprocessed irradiated red phosphorus, specific activity 300 to 500 mCi/g, preparations in the 20 to 50 mmol scale are described, using preferably phosphorus bromides as intermediates and precursors. The following syntheses are given in detail: PCl_3, PCl_5, PBr_3, dimethylphosphite (via trimethylphosphite), diethylphosphite (via triethylphosphite), di-n-butylphosphite, trichlorphone, ethyl-trichlorphone, dichlorphos, butonate; $POBr_3$, 0-phenylphosphoryl dibromide and 0,0-diphenylthiophosphoryl bromide, Systox and homologes, Parathion and methyl-parathion, bromophos; P_4S_{10}, 0,0-dimethyldithiophosphoric acid, bis-(dimethoxy-thiophosphoryl) disulfide, dimethoate and dimethoxone, and Imidan. (auth)

9973 SYNTHESIS AND PROPERTIES OF SOME DIOXO-URANIUM(IV) COMPLEXES WITH FERROCENE DERIVATIVES. Vigato, P. A.; Casellato, U.; Clemente, D. A.; Basdoli, G. (Consiglio Nagionale delle Ricerche, Padua). J. Inorg. Nucl. Chem.; 35: No. 12, 4131-4139(Dec 1973).

A series of uranyl adducts with the ligands ferrocene monocarboxylic acid (L_1), ferrocene 1,1′-dicarboxylic acid (L_2), (1-phenylpropan-1,3-dione)ferrocene (L_3) and 1,1′-di(phenylpropan-1,3-dione)ferrocene (L_4) have been prepared and characterized. The configuration is discussed on the basis of physico-chemical measurements (ir and uv spectra, and molecular weights) in the solid state and in solution. Substitution of coordinated water by neutral monodentate ligands, containing oxygen or nitrogen as the donor atom, is also reported and discussed. (auth)

9974 ACID DISSOCIATION CONSTANTS OF SOME β-KETO ESTERS AND THEIR CHELATE STABILITY CONSTANTS OF DIVALENT TRANSITION METALS AND DIOXOURANIUM(II). Al-Niaimi, N. S.; Al-Saadi, B. M. (Iraq Atomic Energy Commission, Baghdad). J. Inorg. Nucl. Chem.; 35: No. 12, 4207-4216(Dec 1973).

Acid dissociation constants of some β-keto esters, viz. ethyl acetoacetate, ethyl α-phenyl acetoacetate, ethyl α-γ-diphenyl acetoacetate, ethyl α-(phenyl)phenylpropioloylacetate, ethyl α-(α-naphthyl)phenylpropioloylacetate, have been determined potentiometrically in 75 vol% dioxane-water media at 30°C. The "thermodynamic" stability constants of their chelates formed with Mn(II), Co(II), Ni(II), Cu(II), Zn(II) and U(VI) have also been determined. The effects of substituents in the β-keto ester on the equilibria are discussed. (auth)

9975 NOVEL METHOD FOR THE PREPARATION OF PLUTONIUM(III) FORMATE. Crisler, L. R. (Dow Chemical Co., Golden, CO). J. Inorg. Nucl. Chem.; 35: No. 12, 4309-4310 (Dec 1973).

Plutonium(III) formate has recently been prepared, characterized (Crisler, J. Inorg. Nucl. Chem.; 34:3263(1972)) and found to have plutonium reprocessing potential (Crisler, U. S. Patent 3,660,047, (1972)). A nonaqueous synthesis for plutonium(III) formate utilizing plutonium metal and an anhydrous organic dissolution co-solvent (i.e., 50:50 vol % carbon tetrachloride and methyl alcohol) is described. (UK)

9976 STABILITY CONSTANTS OF THORIUM(IV) COMPLEXES WITH α-, β- AND γ-HYDROXYMONOCARBOXYLATE LIGANDS IN AQUEOUS SOLUTION. Magon, L.; Bismondo, A.; Maresca, L.; Tomat, G.; Portanova, R. (Consiglio Nazionale delle Ricerche, Padua). J. Inorg. Nucl. Chem.; 35: No. 12, 4237-4243(Dec 1973).

The complex formation of thorium(IV) with mandelate, glycolate, lactate, α-OH-isobutyrate, β-OH-butyrate and γ-OH-butyrate has been studied by means of potentiometric $[H^+]$ measurements. The stability constants have been determined in aqueous solution with 1 M $(Na)ClO_4$ at 20°C. The data indicate that the β- and γ-hydroxy group, differently from the α-hydroxy group, are not involved in a chelate ring. (auth)

9977 PREPARATION AND PROPERTIES OF URANOCENE, Di-π-CYCLOOCTATETRAENEURANIUM(IV). Streitwieser, A. Jr.; Muller-Westerhoff, U.; Sonnichsen, G.; Mares, F.; Morrell, D. G.; Hodgson, K. O.; Harmon, C. A. (Univ. of California, Berkeley). J. Amer. Chem. Soc.; 95: No. 26, 8644-8649(26 Dec 1973).

Details are given for the preparation of "uranocene," $U(C_8H_8)_2$, from UCl_4 and $C_8H_8^{2-}$ in THF. Uranocene reacts only slowly with water or acetic acid but decomposes with oxygen, bases, and strong acids. It does not undergo electrophilic substitutions or metallation reactions. Its chemistry is discussed in terms of a simple theory of the electronic structure that involves covalent interaction of the highest occupied e_{2u} ligand MO's with metal f_{xyz} and $f_{(x^2-y^2)z}$AO's. (auth)

Radioactive Waste Treatment

Refer also to abstracts 10120, 10134, 10774, and 10787.

9978 (BNWL-1788) RESEARCH AND DEVELOPMENT ACTIVITIES, WASTE FIXATION PROGRAM. Quarterly Progress

Report, July–September 1973. Platt, A. M. (Comp.). Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-1830. 53p. Dep. NTIS $5.45.

The aim of the melt development program is to produce melt-formed ceramic products that have the optimum combination of physical properties for the fixation of radioactive wastes. Depending on thermal treatment many of the ceramics can be in either a glassy or a microcrystalline form. Laboratory and nonradioactive pilot plant tests are being conducted to evaluate both forms. Both PW-4b and PW-6 waste compositions were successfully solidified into borosilicate glass in the development spray solidifier. Calciner wall scaling was minimal and off-gas filter differential pressure remained low during over 26 hours operation in five runs. Glass formation and discharge from the melter proceeded smoothly at melt temperatures ranging from 1050 to 1175°C. Discussions were held with glass industry representatives concerning the design and fabrication of electric glass tanks for the vitrification of high-level wastes. Melting tests in an industrial electric glass tank are planned to check the feasibility of this approach and to obtain design data; a laboratory-scale unit has also been constructed to gain firsthand experience. A series of tests and a stress analysis have shown with good assurance that the leaks which have appeared in the thermowells of several of the WSEP canisters are located at the weld where the thermowells enter the canisters. The welds are located well above the product level in the canisters and the failures are due to stress rather than corrosion. Calculations of helium buildup in waste glass canisters indicate that internal stresses due to helium gas production from the decay of actinide nuclides in the waste may produce sufficient strain to induce cracking of the glass. However, cracking may be avoided by fabricating waste glasses in the form of spheres less than about 8 cm in diameter. (auth)

9979 (BNWL-CC-313) REACTION OF HIGH SALT AQUEOUS PLUS ORGANIC WASTE WITH SOIL. Interim Report. Knoll, K. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Contract AT(45-1)-1830. 8p. Dep. NTIS $3.00.

A study was made to determine if it would be feasible to put a high salt, acidic aqueous waste mixed with organic compounds into the Z-1A tile field. The factors considered were the extent of adsorption of plutonium and americium by the soil and the effect on the infiltration of the waste into the soil by the organic compounds present. It was found that soil has a considerable capacity for the high salt, acidic waste containing organic compounds and can imbibe it almost as readily as water. These data, obtained from column measurements in the laboratory, would be less favorable than those obtained in the field as the moisture cannot spread horizontally in a column. Uptake of plutonium by the soil was very minor and of americium negligible. (auth)

9980 (CEA-CONF-2417) DETAILS OF THE DISPOSAL OF RADIOACTIVE WASTES CONTAMINATED WITH ^{239}Pu. Conche, R.; Philippin, R.; Hayet, L.; Rouffet, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 32p. (In French). (CONF-730667-3). Dep. NTIS (U. S. Sales Only) $3.75.

From meeting of the committee on hot laboratories of Euratom; Goesthacht, F. R. Germany (14 Jun 1973).

The processing and storage of radioactive wastes contaminated with ^{239}Pu necessitate special care. The γ activity and the very long lifetime of ^{239}Pu (24,000 yr) impose air-tight casings. At Fontenay-aux-Roses these wastes are processed in shielded cells. The volume reduction of compressible wastes, confinement in air-tight casings, and the transport of the wastes to decay stations or for storage in air-tight devices is described in some detail. (tr-auth)

9981 (EGU-5130702) RADIOIODINE BEHAVIOR AND REMOVAL IN NUCLEAR POWER STATIONS. Hladky, E. (Vyskumny Ustav Energeticky, Jaslovske Bohunice (Czechoslovakia)). 1972. 121p. (In Czech). INIS.

The study of the removal of radioiodine and methyl iodide by Al_2O_3 impregnated with $AgNO_3$ showed that radioiodine could sufficiently be removed on pure Al_2O_3 but for the removal of methyl iodide the impregnation of Al_2O_3 was necessary. At $AgNO_3$ concentrations exceeding 200 g/kg of the sorbent and at the contact time greater than 0.1 sec, both components could be removed with sufficient efficiency. Increasing the relative humidity of the carrier gas up to 90% did not considerably affect the sorption efficiency at contact times exceeding 0.5 sec. The quality of the sorbent affected the distribution of I_2 and CH_3I in the column; aging resulted in a decreased efficiency. Nevertheless, even after 7½ months of aging, the sorbent efficiency was sufficient for the CH_3I removal. The desorption of radioiodine from impregnated alumina only proceeded above 600°C indicating a strong binding strength of I_2 in the impregnated material. CH_3I is formed in nuclear power stations due to pyrolytic and radiation mechanisms. A mathematical model was proposed for describing the pyrolytic processes and its experimental verification proved its validity. The radiolysis of methane in mixtures with iodine proceeds by means of the reaction of methyl radicals with iodine molecules, the radicals are formed by highly excited and ionized methane molecules. At temperatures of up to 250°C the radiolytic processes prevail, at 350°C pyrolysis is the main process. At these temperatures simultaneous irradiation resulted in the formation of various chains and the process was affected by the presence of H atoms, CH_3 radicals and electrons resulting from the radiation interaction with matter. (INIS)

9982 (ORNL-4792) USE OF ION EXCHANGE FOR THE TREATMENT OF LIQUIDS IN NUCLEAR POWER PLANTS. Lin, K. H. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 108p. Dep. NTIS $5.45.

The current and future use of ion exchange (demineralization) as a method for treating liquid radioactive streams at nuclear power plants was investigated. Pertinent data were obtained by contacting utility companies, nuclear-steam-supply system vendors, selected AEC-operated facilities, as well as ion exchange resin and equipment manufacturers. Principal emphasis was on obtaining data concerning the decontamination of aqueous solutions characterized by levels of radioactivity that range from 10^{-7} to 1 μCi/ml. Ion exchange media commonly used in nuclear power plants are synthetic organic resins of polystyrene matrix. They are utilized primarily in the mixed-bed (deep-bed) ion exchange system. Powdered resin (mixed) systems (so-called "filter-demineralizer") are also used in several recent boiling-water-reactor plants. The term decontamination factor (DF), the ratio of the feed to effluent concentration, is widely used and is assumed by designers and operators of the plants to express the ion exchange system performance. In some cases, such DF values may not represent the true system performance. To achieve a desired DF, the feed and effluent must be sampled for the nuclides of interest and the processing discontinued when the desired effluent concentration is exceeded. Average DF values that can be obtained for various ion-exchange systems and various groups of radionuclides if good engineering practice is used in the design and operation of these systems are listed. These values are based on ion-exchange fundamentals, literature data, laboratory experiments, and plant operating experience. They represent time-average values expected under normal operating conditions rather than maximum values attainable under optimum conditions. (auth)

9983 (ORNL-TM-4409) FISSION PRODUCT GAS RETENTION STUDY. Final Report. North, E. D.; Booth, R. L. (Nuclear Fuel Services, Inc., Rockville, Md. (USA)). Aug 1973. Subcontract 3607. 119p. AT.

For Oak Ridge National Lab., TN.

Various processes have been evaluated which would provide improved plant containment factors of 100 for tritium and 10,000 for iodine at a reprocessing plant for light water reactor fuels. The goals for krypton and iodine can be obtained although a factor of 1,000 for iodine appears to be more practical. The goal for tritium must await further development of the voloxidation process or the use of alternative methods. The cost of providing improved containment for these isotopes at the West Valley Reprocessing Plant is estimated to be $16,900,000; of which $10,000,000 is primarily for recovery of tritium, $4,000,000 for recovery of krypton, and $2,900,000 is for recovery of iodine. Improved containment of iodine should be provided at existing and future reprocessing plants. Development work should be continued in processes for improved containment of krypton and tritium although the need for such processes will not develop in this decade. (auth)

9984 (UCRL-75243) CONSIDERATIONS IN SITING LONG-TERM RADIOACTIVE NOBLE GAS STORAGE FACILITIES. Cohen, J. J.; Peterson, K. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1973. 15p. (CONF-730915-10). Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

Cost-benefit analysis indicates that it would be prudent policy to require the prevention of ^{85}Kr release from fuel reprocessing plants at the present time, assuming this can be accomplished at a cost amounting to less than $1.00/Ci. Options are discussed for accomplishment of ^{85}Kr release prevention from fuel reprocessing plants. No value judgments have been attempted in evaluating these options. However, it has been assumed that a policy of concentrating effluent noble gases, retaining them in pressurized storage tanks, and storing them for long periods at some centralized facility will be adopted. Such a policy would appear to be consistent with current AEC policy on high-level waste management. Criteria for siting a long-term noble gas storage facility should include assurance that in the event of a containment failure: (a) max-

imum permissible dose guidelines (0.5 rem/yr for whole body and 3.0 rem/yr for skin) are not exceeded, and (b) resultant population doses (man-rem) are minimized. Five hypothetical sites have been evaluated to estimate population doses in the event of leakage. From this analysis it appears that geographic siting may be considered relatively unimportant. Site selection should be based on cost-benefit studies considering: (a) transportation and handling costs, (b) maintenance and surveillance costs, and resultant health benefits derived in terms of potential population dose averted. (auth)

9985 TREATMENT PROCESS. Queiser, H.; Meichsner, O. (to Licentia Patent-Verwaltungs-GmbH). US Patent 3,773,177. 20 Nov 1973. Priority date 20 Jul 1970, F.R. Germany. 8p.

A method for decreasing the liquid content of radioactive concentrates from nuclear power plants is described. Concentrates from a resin-bed ion exchange filter system and from at least one other concentrating stage (mechanical filters, settling basin, etc.) are combined and fed to a filter-cake-producing filter for dewatering and drying. The concentrates from the other concentrating stage must have a smaller particle size than that from the resin-bed ion exchange filter and a lower salt content than that from the evaporation concentrator. The concentrates from the evaporation concentrator bypass the filter-cake-producing filter and goes directly into transport and storage containers where it is dewatered and dried to the desired water content for storage. Solidification of these radioactive wastes makes storage more economical. (LK)

9986 REMOVAL OF ^{60}Co AND ^{65}Zn FROM A SOLUTION CONTAINING SODIUM SALTS BY DOWEX A-1. Matsuzuru, H.; Wadachi, Y. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 551-555(Sep 1973).

Removal of ^{60}Co and ^{65}Zn from aqueous solution in a column by the chelating resin Dowex A-1 was studied in its relation to pH, to the concentration of sodium salts added to the influent and to the flow-rate of the influent. It was found that the decontamination factors (DF) of ^{60}Co and ^{65}Zn both increase consistently with pH between 3.5 and 5.0, beyond which the DF falls back. In relation to sodium salt concentration, the DF value decreases consistently with increasing concentration in the range of 0.1 to 1.0 N, above which, further addition of sodium salts has no further effect. The DF value is completely independent of flow-rate of the influent in range of 10 to 160 hr^{-1} space velocity. It is, further, very little affected by differences in effluent volume, in the range from 6.7 to 1.3×10^3 bed volumes. For the regeneration of the resin, about 99.9% of ^{60}Co or ^{65}Zn is removed from the resin by at least 3 bed volumes of 0.1 M EDTA or 0.1 M NTA used as the regenerating solution. (auth)

Radioisotope Production

Refer also to abstracts 9904, 11473–11475, and 11495.

9987 (DP-1333) PROCESSING OF ^{238}Pu AND ^{237}Np WITH MACROPOROUS ANION EXCHANGE RESIN. Thompson, G. H.; Burney, G. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1973. Contract AT(07-2)-1. 19p. Dep. NTIS $4.00.

"Dowex" MSA-1 macroporous anion exchange was found to be superior to "Dowex" 1 gel-type resin for separation and purification of ^{238}Pu and ^{237}Np. Higher actinide loading per unit of resin is attained, and elution is accomplished in smaller volume. Cross-contamination of the products is lower with macroporous resin, and higher processing rates can be attained. Process performance with different lots of macroporous resin is more consistent than generally obtained with different lots of "Dowex" 1 resin because the high porosity of the macroporous resin facilitates ionic diffusion. The chemical, thermal, and radiolytic stabilities of macroporous and gel-type resins are similar. (auth)

9988 (NP-19902) USE OF THERMOCHROMATOGRAPHY FOR RAPID CHEMICAL SEPARATION. Part I. Application to Steady State Separation of Fission Product Isobars Obtained with An Isotope Separator On-line a Reactor. Grapengiesser, B.; Rudstam, G. (Forskningsraadens Lab., Studsvik (Sweden)). 1973. 32p. (LF-43). Dep. NTIS (U.S. Sales Only) $3.75.

In ISOL-systems many elements may be processed simultaneously through the isotope separator. The samples will then, as a rule, contain several isobaric components, which calls for a chemical separation step. By using thermochromatographic techniques an apparatus has been constructed and attached to the collector side of the OSIRIS-facility. The apparatus permits a very rapid chemical separation to be carried out. Thus, halogen isotopes with half-lives of the order of 1–2 seconds have been successfully purified from accompanying isobaric contamination. (auth)

9989 (NP-19903) USE OF THERMOCHROMATOGRAPHY FOR RAPID CHEMICAL SEPARATION. Part II. Determination of Deposition Temperatures. Rudstam, G.; Grapengiesser, B. (Forskningsraadens Lab., Studsvik (Sweden)). 1973. 40p. (LF-44). Dep. NTIS (U.S. Sales Only) $4.00.

The deposition temperatures of elemental states and/or chemical compounds of the elements Na, Co, Zn, Ge, As, Br, Rb, Ag, Cd, In, Sn, Sb, Te, I, Cs, and Ba have been determined. In the majority of cases the material where the deposition takes place has been quartz, but some data for other materials have also been obtained. (auth)

9990 SEPARATION OF NUCLEAR REACTION PRODUCTS FROM TARGETS OF URANIUM OXIDES BY CYCLIC PHASE TRANSFORMATION IN THE STOICHIOMETRIC REGION $UO_{2.50}$–$UO_{2.67}$ AND THE THERMOCHROMATOGRAPHIC SEPARATION OF VOLATILIZED COMPONENTS. Eichler, B. (Joint Inst. for Nuclear Research, Dubna, USSR). J. Inorg. Nucl. Chem.; 35: No. 12, 4001-4010(Dec 1973). (In German).

An account is presented of the separation of nuclear reaction products from targets of uranium oxide by cyclic phase transformation in the stoichiometric region $UO_{2.50} \ldots UO_{2.67}$ and the thermochromatographic separation of volatilized components. Targets of uranium oxide irradiated by 660-MeV protons were separated in the process of cyclic reduction oxidation reactions. Rare gases and elements Cd, I, Hg, Tl, Po, and At were separated with a high efficiency (>90%). The yield of elements In, Sn, Sb, Te, Pb, and Bi depends on the value $\Delta H^0_{298}(g)$ of different elements. After the separation the carrier-free elements were volatilized in a hydrogen gas stream and were adsorbed in groups in a temperature gradient tube. For the elements which probably exist in elementary states a correlation was found between the adsorption temperature and the value $\Delta H^0_{298}(g)$ for gaseous elements in atomic states. It follows that the hypothetical superheavy elements with Z = 112 ... 118 could be separated by the method described from uranium targets with a high efficiency and selectivity from actinides. The elements Z = 112 ... 118 should be adsorbed in the region of T < 350°C. (auth)

9991 MULTIPLE-DOSE ^{133}Xe SOLUTION GENERATOR: THE DISPOSABLE GLASS AMPULE EQUILIBRATION CHAMBER. Carroll, R. G.; Berke, R. A.; Anger, R. T.; Levine, G.; Wellman, H. U.; Saenger, E. L. (Univ. of Cincinnati). J. Nucl. Med.; 14: No. 12, 935-938(Dec 1973).

To have a continuously available supply of ^{133}Xe saline solution at low cost, a system based on the concept of dynamic equilibrium between a trapped bubble of ^{133}Xe gas and a small volume of periodically renewed saline has been designed. Unidirectional flow of saline within an all-glass vessel and the unique ampule design contribute to an extremely low xenon loss rate. High concentrations of xenon in saline are readily obtainable. The system consists of a glass ampule, a tap unit, shielding, and a fresh saline supply unit. The xenon concentrations per milliliter routinely obtained with this equilibrium chamber substantially exceed the "... up to 5 mCi Xe/ml" previously reported for glass ampule systems. No transfer vessel is required. (auth)

9992 ELECTRON LINEAR ACCELERATOR PRODUCTION OF ^{43}K. Gray, F. C.; Cole, C. M.; Meaburn, G. M.; Brunhart, G. (Armed Forces Radiobiology Research Inst., Bethesda, MD). J. Nucl. Med.; 14: No. 12, 931-932(Dec 1973).

Carrier-free radiopharmaceutical ^{43}K as KCl was produced by the ^{44}Ca(γ,p)^{43}K reaction induced by bremsstrahlung radiation from an electron linear accelerator. An irradiation of 1 hr using 5.4 kW of 45-MeV electrons passing through a thick tantalum converter produced yields in excess of 1.5 mCi/g ^{44}CaO. The ^{43}K was separated from the target material and prepared as ^{43}KCl using ion-exchange chromatography. This radiopharmaceutical is now being prepared in millicurie quantities for myocardial imaging, electrolyte studies, and other uses for which ^{40}K and ^{42}K are unsuited. (auth)

9993 GENERATION OF A SUPPLY OF RADIONUCLIDE. Gerhart, J. M. (to G. D. Searle and Co.). US Patent 3,774,036. 20 Nov 1973. Filed date 23 Feb 1972. 8p.

A method and apparatus for generating and maintaining an available supply of a radioactive eluate with at least a minimum level of activity is described. A relatively short-lived daughter radionuclide is produced by the radioactive decay of a relatively longer-lived radionuclide in a radionuclide generating chamber. The daughter radionuclide is separated from the parent radionuclide by use of an eluting solution. The resultant solution is recycled through the generator chamber to replenish and concentrate the amount of daughter radionuclide contained therein. Because a relatively large amount of eluate is produced and maintained at at least a minimum level of radioactivity, it is

possible to easily meet fluctuating demands for the daughter radionuclide. (18 Claims, 4 Drawing Figures) (Official Gazette)

9994 CYCLOTRON PRODUCTION OF ^{197m}Hg AND ITS USE FOR LUNG TUMOR IMAGING. Hara, T. (National Sanitorium of Nakano, Tokyo); Iio, M.; Hirata, M.; Karasawa, T. Int. J. Appl. Radiat. Isotop.; 24: No. 11, 661(Nov 1973).

Due to the many disadvantages of using reactor made ^{197}Hg, which are listed, it was decided to initiate the cyclotron production of this isotope since its use for the positive identification of lung tumors by external scintillation imaging has been proven. The irradiation procedure and the subsequent distillation process are described. (UK)

9995 HIGH-YIELD ZINC-68 CYCLOTRON TARGETS FOR CARRIER-FREE GALLIUM-67 PRODUCTION. Brown, L. C.; Callahan, A. P.; Skidmore, M. R.; Wilson, T. B. (Oak Ridge National Lab., TN). Int. J. Appl. Radiat. Isotop.; 24: No. 11, 651-655(Nov 1973).

An enriched ^{68}Zn cyclotron target design has been developed for the large-scale (3 to 4 Ci/8 hr) production of carrier-free ^{67}Ga with ≤5% ^{66}Ga contamination as of end of bombardment. An efficient and rapid ^{68}Zn target recovery procedure has also been developed and tested for recycling of the target material with minimal losses (≤5% each cycle). (UK)

9996 PREPARATION OF ^{119}Sb FOR MOESSBAUER SPECTROSCOPY OF ^{119}Sn. Ambe, F.; Ambe, S.; Shoji, H. (Inst. of Physical and Chemical Research, Wako, Japan). Radiochem. Radioanal. Lett.; 15: No. 6, 349-352(19 Dec 1973).

A radiochemical procedure is described for separating ^{119}Sb (a source nuclide for ^{119}Sn-Moessbauer spectroscopy) from proton-irradiated tin targets. The yield of ^{119}Sb amounts to about 90% and the decontamination factor of tin is more than 5×10^6. (auth)

9997 NOVEL METHOD OF PRODUCING RADIOACTIVE IODINE. Shikata, E.; Amano, H. (to Japan Atomic Energy Research Inst.). US Patent 3,772,146. 13 Nov 1973. Priority date 23 Mar 1970, Japan. 6p.

Radioactive iodine (^{131}I) is easily obtained by heating, a temperature preferably ranging from 400 to 700°C, tellurium trioxide, which was irradiated with a neutron flux. Thus, the complicated operations required in a conventional process for separation and/or purification of the product are eliminated. (Official Gazette)

9998 METHOD AND SYSTEM FOR GENERATING AND COLLECTING A RADIONUCLIDE ELUATE. Litt, G. J. (to New England Nuclear Corp.). US Patent 3,774,035. 20 Nov 1973. Filed date 12 Jul 1971. 6p.

A method and system for filling a vial with an eluate containing a radionuclide by coupling a vial containing a prepackaged amount of eluant to both an inlet to a radionuclide generator column and a vent outlet and coupling an evacuated vial to an outlet from the radionuclide column are described. The method and system may utilize a filter which includes an eluate repellent portion. (Official Gazette)

Reactor Fuel Reprocessing

Refer also to abstract 9845.

9999 (DP-1337) DISSOLVING URANIUM OXIDE-ALUMINUM FUEL. Perkins, W. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Nov 1973. Contract AT(07-2)-1. 23p. Dep. NTIS $4.00.

The dissolution of aluminum-clad uranium oxide-aluminum fuel was studied to provide basic data for dissolving this type of enriched uranium fuel at the Savannah River Plant. The studies also included the dissolution of a similar material prepared from scrap uranium oxides that were to be recycled through the solvent extraction process. The dissolving behavior of uranium oxide-aluminum core material is similar to that of U-Al alloy. Dissolving rates are rapid in HNO_3-$Hg(NO_3)_2$ solutions. Irradiation reduces the dissolving rate and increases mechanical strength. A dissolution model for use in nuclear safety analyses is developed, based on the observed dissolving characteristics. (auth)

10000 (ORNL-tr-2788) MECHANICAL DECLADDING OF STAINLESS-STEEL-CLAD OXIDE FUELS. Matcheret, G.; Bourgeois, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Aug 1973. Translated by Martha Gerrard from CEA-R-4469. 21p. Dep. NTIS $3.25.

A mechanical decladding method applicable to LWR or LMFBR oxide fuels is described. First, the fuel pins are chopped. Then the obtained pieces are crushed or hammered in order to separate oxides as powder from the cladding material. Very good results were obtained for RAPSODIE fuel pins irradiated in the range 33,000-50,000 $MWdt^{-1}$. This method is not specific for the cladding material; the obtained powder can be fed continuously either in an aqueous or in a nonaqueous plant. (auth)

10001 (RT/CHI-(73)4) GAS CHROMATOGRAPHIC ANALYSIS OF THE DEGRADATION PRODUCTS OF TBP IN SOLUTIONS IN THE REPROCESSING OF IRRADIATED NUCLEAR FUELS. Brignocchi, A.; Gasparini, G. M.; Pizzichini, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Jul 1973. 28p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.50.

The products formed from tributyl phosphate in different diluents were analyzed quantitatively for components by gas chromatography. Methylation yields and limits of detection of dibutyl phosphate and monobutyl phosphate are given. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 10090, 10326, 10578, 10583–10585, 10589, 10592, 10655–10660, 10669–10682, 10743, 11909, 11952, 11961, and 11983.

10002 (CONF-720613-P1) THERMIONIC ELECTRICAL POWER GENERATION. Volume 1. Proceedings of 3rd International Conference, Juelich, June 5–9, 1972. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany); International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, Paris (France)). 1972. 464p. (In several languages).

Thirty-three papers were presented. A separate abstract was prepared for each of 28. Texts were not included for 2 papers. Three papers were previously abstracted in NSA. For abstracts of these see CONF-720613– (Vol. 1) in the Report Number Index. (LCL)

For abstracts of individual papers see: 10003, 10004, 11909, 11952–11974, 12182, and 12183.

10003 (CONF-720613-P1, pp 67-80) STATE OF DEVELOPMENT OF AN ACTINIUM FUELED THERMIONIC GENERATOR. Birnbreier, H. (Brown, Boveri and Cie AG, Mannheim, Ger.); Gammel, G.; Dumont, G.; Poskin, M.; Baetsle, L. H.; van Lierde, W. (1972).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Three main topics concerning the ^{227}Ac thermionic generator built in cooperation between BBC and UM are presented: the prototype 30 W(t) heat source; the technology developed for the joining of the heat source and the converter; and life tests of converters and components. A prototype heat source of this conception was fabricated containing about 2 g of Ac in the form of Ac_2O_3 – representing nearly 30 W(t). The source was tested for about 2000 h at 1800°C. The technology of the joining of the heat source and the converter is presented. The two methods developed are a solid diffusion bonding with and without an intermediate activating layer. The capsule and emitter block are both a W-25 Re alloy; the intermediate layer used was Ni. Detailed information concerning life tests of converters and converter components is given. (auth)

10004 (CONF-720613-P1, pp 85-94) FLAME HEATED THERMIONIC CONVERTER. Shroff, A. M.; Grauleau, D.; Molnar, F. (Thomson-CSF-GTE, Orsay, France). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A flame-heated heat pipe thermionic converter unit is described. It consists of a special petrol furnace which can operate at 1400°C; a heat pipe made of TZM alloy with lithium as the working fluid and used to indirectly heat the converter emitter; and the thermionic converter. Information is given on furnace operation and performance, heat pipe design and operation, material protection against corrosion, and converter construction and performance. The flame-heated heat pipe converter is operational. The only limiting factor is the protection against oxygen corrosion at high temperature. From the various solutions adopted, molybdenum disilicide coating is the most promising. The efficiency when operated in the furnace is around 5%. Fifty hours of life testing have been completed and are continuing. The diodes have been put in series and the total output power converted to alternating current at 220V. (LCL)

10005 (CONF-720613-P2) THERMIONIC ELECTRICAL POWER GENERATION. Volume 2. Proceedings of 3rd International Conference, Juelich, June 5–9, 1972. (Kernforschungsanlage, Juelich G.m.b.H. (F. R. Germany); International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, Paris (France)). 1972. 561p. (In several languages).

Thirty-nine papers presented at the conference are included in Volume 2. A separate abstract was prepared for each of thirty-five papers. Two papers were previously abstracted in NSA as 27: 2471 and 28: 23751. (JRD)

For abstracts of individual papers see: 10006–10009, 10326, 10582–10591, 10644, 10655–10659, 10669–10672, 10743, and 11975–11983.

10006 (CONF-720613-P2, pp 501-515) BALANCE SHEET OF SIX YEARS OF LABORATORY TESTS OF CONVERTERS. Clemot, M.; Gayte, B.; Tripet, J. (CEN, Saclay, France). 1972. (In French).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Conclusions as to the performance, life-time, and stability of thermionic converters are presented. These conclusions are based on a statistical analysis of data from testing 40 different thermionic converters. The converters, with the exception of nine metal ones which failed because of their poor behavior under heat, each have an emitter surface of 20 cm^2, an Al_2O_3 insulator, and a cold electrode spacing of the order of 200 μm. An emitter layer of W permits both a decrease in the evaporation rate and an increase in the reliability and lifetime of the converters. The problem of interdiffusion between Mo and W can be controlled by deposition conditions. With respect to the collectors, the choice of Nb–1% Zr is imposed by the established getter effect. The tests clearly indicated the selection of a converter with Mo–W emitters and Nb–1% Zr collectors. (JSR)

10007 (CONF-720613-P2, pp 593-600) EXPERIMENTAL TESTS ON THERMIONIC CONVERTERS WITH CONICAL ELECTRODES. Gregorius, K.; Janner, K. (Siemens AG, Erlangen, Ger.). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In order to examine the feasibility of a thermionic converter with a variable electrode gap, using cylinderlike electrode shape, an experimental converter with conical electrodes was built and operated during 1967 and 1968. The current-voltage characteristics of the electrode pairings W–Mo and Mo–Mo which were measured with it are given. The optimum electrode gap was 0.13 mm. The maximum power density at an emitter temperature of 2030°K and a collector temperature of 870°K was 30 W/cm^2 and the maximum internal efficiency 22%. Some of the characteristic curves showed several ignition points. The parting of electrode contacts, deliberately formed, did not cause any damage to the electrodes. (auth)

10008 (CONF-720613-P2, pp 693-703) QUALITY INSPECTION OF MULTI-LAYER COLLECTOR SYSTEMS. Boehm, H.; Kaspar, G.; Peehs, M.; Schoerner, H. (Siemens AG, Erlangen, Ger.). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Methods for quality inspection of collectors have been developed parallel to the technological manufacturing. Semi-finished products are tested for microstructure, cracks and micro-hardness. When the Al_2O_3 layer has been applied on the collector, the insulation layer is tested for cracks and breakdown strength. Completely assembled and machined systems are tested electrically (resistance–characteristic, breakdown strength 100 V at 700°C, loss angle). To find out bonding defects of fully assembled collectors, the systems were tested ultrasonically and with infrared camera. For testing the heat transfer, an apparatus using liquid metal as the heat transfer medium is used (test load ≤ nominal load). However, this method is not nondestructive. For this reason, a nondestructive method has been developed in which the thermal diffusivity is measured. Specifications are given for quality inspection during manufacturing. (auth)

10009 (CONF-720613-P2, pp 705-723) INVESTIGATION OF INSULATION MATERIALS FOR THE ANODE PACKET OF A THERMIONIC CONVERTER FROM STATISTICAL CONTROL DATA. Dunaeva, T. Yu.; D'yakov, B. B. (Ioffe Inst. of Physics and Tech., Leningrad). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

When operating anode packets in thermionic emission converters, two possible reasons for the breakdown of their insulation layers have to be considered: monotonic decrease of integral properties such as resistivity (ρ) and thermal conductivity (λ), or local imperfections of the layer structure. Since these imperfections influencing the efficiency of the packet operation, even at satisfactory values of ρ and λ, are stochastic in origin in both space and time, they have been investigated by statistical methods which take into account their physical causes. The dielectric strength (E) of the insulation layers, as obtained by plasma sputtering, may be determined approximately by the

distribution function $P(E) = \exp(-E^{\beta}/\alpha)$. The two parameters α and β contain information regarding the generation processes of such layers and the inhomogeneities in them, as well as the time variation of the dielectric strength. The parameter β is related to the nature of the inhomogeneities, i.e., porosity and pore dimension; α depends on the breakdown voltage. In the experiments, the insulation layer was pierced by an electrode "needle plane" in which the linear dimension (γ) of the affected surface was much smaller than the layer thickness. On separate samples there were more than 100 breakdown locations. This was sufficient for a statistical analysis using both a breakdown voltage, i.e., for immediate breakdown, or a constant voltage at a given level. The parameters α and β were determined both graphically and by the method of greatest probability on a EVM BESM-4 computer. Beta was found to be practically independent of the properties of the pore filling medium. A method was developed for the construction of the required function P(E) which was independent of γ and of the thickness of the layer used for the determination of the mean breakdown voltage. E_{min} is equal to the breakdown voltage of the environment and, under conditions of high vacuum, is equal also to the true breakdown voltage of the insulation material for a given field inhomogeneity at the electrode. The determination of the time-dependent functions $\alpha(t)$ and $\beta(t)$ gives a measure of the aging of the anode taking place under the influence of one process with relatively high kinetic and of other processes, i.e., recovery of ceramics, with less rapid kinetics. Results of investigations of both processes are presented. (auth)

10010 (CONF-720613-P3) THERMIONIC ELECTRICAL POWER GENERATION. Volume 3. Proceedings of 3rd International Conference, Juelich, Jun 5–9, 1972. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany); International Atomic Energy Agency, Vienna (Austria); Nuclear Energy Agency, Paris (France)). 1972. 752p. (In several languages).

Fifty-two papers were presented. A separate abstract was prepared for each of 50. Two papers were previously abstracted in NSA. For abstracts of these see CONF-720613-(Vol.3). (LCL)

For abstracts of individual papers see: 10011–10048, 10592, 10660, and 10673–10682.

10011 (CONF-720613-P3, pp 1027-1059) METHODS FOR IMPROVING THERMIONIC CONVERTER PERFORMANCE. Rasor, N. S. 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Methods for improving thermionic converter performance are described and compared. These methods include cesium diode improvement, vacuum diode, unignited triode, ignited triode, and pulse-enhanced diode. From this comparison it is concluded that, with one exception, the prospects for substantially improving the performance of the thermionic converter depend on utilization of a new generation of electrode materials and structures, and not on new developments in plasma technology. Recognition of the existence of a desirable performance regime is necessary to define and justify the materials development that makes it possible. Therefore, basic work on advanced electrode development and advanced converter types should proceed simultaneously. (LCL)

10012 (CONF-720613-P3, pp 1061-1080) EXPERIMENTAL ANALYSIS OF CONVERTER PERFORMANCE. Rufeh, F. (Thermo Electron Corp., Waltham, MA). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Experimental programs have been underway for more than a decade to establish and compare the thermionic performance of various electrode surfaces. Five years ago, the volt-ampere characteristics of some of the converters were subjected to detailed examination that showed that, in some of the converters, raising the collector temperature results in a decrease in emitter work function. It is well known that such an effect is not present in a clean cesium converter and the effect must be caused by the presence of an additive on the collector surface which is evaporated to the emitter to reduce its work function. A large number of experiments were performed to determine how the unintentional additive formation could be avoided so that the performance of clean electrodes could be evaluated. Variable spacing converters were constructed, processed and tested in an identical manner. A variety of emitter and collector surfaces were used. The converters tested were divided into two groups. In the first group, converters with the same emitters were used to compare collector surfaces. In the second group, converters with the same collectors were used to compare emitter surfaces. A number of preferred oriented tungsten emitters examined in thermionic converters showed a strong qualitative correlation among bare work function, cesiated emission, and power output of the emitters with a high degree of reproducibility. Examination of a number of collector surfaces showed that polycrystalline Nb, polycrystalline W, and polycrystalline Mo surfaces are identical as thermionic collectors, but electropolished (110) W and Mo collectors are superior. The power output from these collectors could not be correlated with the collector work function. (LCL)

10013 (CONF-720613-P3, pp 1081-1089) EVALUATION OF SUBLIMED MOLYBDENUM COLLECTOR COATINGS FOR ADDITIVE DIODE OPERATION. Dunlay, J.; Matsuda, S.; Poirier, V. (Thermo Electron Corp., Waltham, MA). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Experiments are described which were performed to demonstrate that oxygen additive performance of thermionic diodes could be achieved with sublimed collector coatings and that the use of sublimed coatings is a practical means of fabricating additive thermionic diodes. Collector coatings were formed by sublimation of Mo directly on a Nb substrate. In one set of tests, a tungsten heat pipe was used to heat the emitter uniformly. In a second set of tests the configuration of a thermionic fuel element was used with electrical heating of the emitter. During a 2 yr period a total of 6 cylindrical diodes were fabricated using sublimed Mo collector coatings. All of these diodes exhibited oxygen additive performance. The initial 1000 hr life test indicated the need for higher 0 concentrations. The current life test is investigating a higher 0 content coating and has accumulated 3000 hr of stable operation. (LCL)

10014 (CONF-720613-P3, pp 1091-1102) UTILIZATION OF TUNGSTEN OXIDES FOR ADDITIVE THERMIONIC CONVERTERS. Lieb, D.; Rufeh, F. (Thermo Electron Corp., Waltham, MA). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The potential of oxygen as an additive for improving the performance of thermionic converters has long been recognized. Experiments are described which were performed to evaluate the use of a metal oxide coating on the collector surface as an oxygen source for achieving this improvement. An ultrahigh vacuum chamber was constructed and the formation of metal oxides and their effect on the emitter work function were studied. The promising oxides studied in the metal oxide chamber were then formed in thermionic converters according to the procedure found in the metal oxide apparatus. Their cesiated performance was recorded and compared with the performance of the same electrodes without the pressure of the metal oxide. It was concluded that oxides which influence emitter work function can be deposited on the collector. Tungsten oxides formed on the emitter and evaporated to the collector are able to elevate emitter work function, while Mo oxides formed on the collector at the conditions of this experiment are unable to produce this effect. Further, in fabricating and processing nonadditive converters, care must be taken to avoid formation of oxides on the electrode surfaces, since oxygen pressures as low as 5×10^{-6} torr and tungsten electrode temperatures of 1000°K are adequate for oxide formation. (LCL)

10015 (CONF-720613-P3, pp 1103-1115) CESIUM OXIDE–CESIUM SOLUTION AS A SOURCE OF CESIUM AND OXYGEN. Gunther, B. (Thermo Electron Corp., Waltham, MA); Rufeh, F.; Pigford, T. H. 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The feasibility of using a Cs_2O–Cs solution as a source of Cs and O for improving the performance of thermionic converters is discussed. The experimental system designed for systematically investigating this feasibility is described. Preliminary test data are presented. (LCL)

10016 (CONF-720613-P3, pp 1117-1126) INVESTIGATIONS OF THE COLLECTOR MATERIAL WORK FUNCTION INFLUENCE ON THE ELECTRICAL CHARACTERISTICS OF THERMIONIC CONVERTERS IN AN ARC MODE. Gverdtsiteli, I. G.; Kudziev, A. G.; Kucherov, R. Ya.; Tsakadze, L. M.; Tskhakaya, V. K. (Physical-Technical Inst., Sukhumi, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Studies of the electrical characteristics of the thermionic con-

verter with the emitter of (110)-oriented single-crystal molybdenum and the collector of single crystal molybdenum and niobium with (110)-oriented crystallographic planes and of polycrystalline niobium are described. It is shown that in an arc mode the electrical characteristics of the thermionic converter do not depend on the anode material work function when: the cathode materials are the same; the cathode temperature, electrode gap, and cesium vapor optimal pressure for each anode temperature are at fixed values; and either the output voltage is at a certain value V_{cr} or the thermionic current density is j_{cr}. At output voltages exceeding V_{cr} (or at $j < j_{cr}$) the thermionic converter specific power increases with an increase in the anode material vacuum work function. J_{cr} has various values depending on the vacuum work function magnitude of collector materials. However, this value for the given pair of electrodes is a constant value. Apparently, there is a particular conjunction between the value j_{cr} and the anode-side barrier that is under study at present. (auth)

10017 (CONF-720613-P3, pp 1127-1138) INFLUENCE OF MAGNETIC PRESSURE ON THE PERFORMANCE OF A HIGH-CURRENT DISCHARGE THERMIONIC CONVERTER. Nevolin, V. K.; Tsiberev, V. P.; Tskhakaya, V. K.; Yarygin, V. I. (Physical-Technical Inst., Sukhumi, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Results are presented of theoretical and experimental investigations into the influence of magnetic compression on the performance of a high-current cylindrical thermionic converter with cesium-barium filling at low pressures. The results of calculations are compared with experimental data. The experimental profiles of the current density along the converter at different total currents are shown. (auth)

10018 (CONF-720613-P3, pp 1139-1149) HIGH TEMPERATURE CESIUM VAPOR SOURCES BASED ON A CESIUM-GRAPHITE SYSTEM FOR THERMIONIC CONVERTERS. Gverdtsiteli, I. G.; Kalandarishvili, A. G.; Tskhakaya, V. K. (Physical-Technical Inst., Sukhumi, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Results are presented of the measurement of the pressure of saturated cesium vapor above a cesium-graphite system at different cesium concentrations in the graphite. The properties of the arc mode of a thermionic converter in which the cesium vapor source was a cesium-graphite system were investigated. It was shown that the use of cesium-graphite in thermionic converters leads to an increase of the working temperature of the cesium reservoir and to a simplification of the stabilization of a given mode of the converter. (auth)

10019 (CONF-720613-P3, pp 1151-1175) INVESTIGATION OF PHYSICAL PROCESSES AND OPTIMIZATION OF THERMIONIC CONVERTERS WITH Cs–Ba FILLING. Babanin, V. I.; Dunaev, Yu. A.; Mustafaev, A. S.; Sitnov, V. I.; Ender, A. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Results of experiments on Cs–Ba filled thermionic converters are presented. These investigations principally involved a determination of the factors affecting the maximum output power from such a thermionic converter. The Cs–Ba filled converter was used because with it, it is possible to independently control the cathode output performance while attaining maximum current densities for given values of T_K and P_{Cs}. The principal instrument for investigation of a thermionic converter in the high-current Knudsen mode of operation was the transverse magnetic field. The fundamental characteristics of the plasma and the cathode surface in the undercompensated mode were determined by means of the transverse magnetic field. It was found that in a deeply Knudsen mode, the ion concentration in the narrow cathode boundary layer may greatly exceed the atom concentration. The role of the molecular pressure during the delivery of cesium vapors from the cesium reservoir into the active volume was emphasized. A consecutive increase in the effective degree of contrast of the cathode surface with increasing compensation degree, γ, was detected. This was obviously connected with the successive opening of spots. An investigation of the transition to the undercompensated mode has shown that for fixed values of T_K and P_{Cs}, the maximum value of saturation current, J_0, is attained when $\gamma \sim 0.4$. The calculated values of J_0 were in good agreement with the experimental data. Relations between J_0 and P_{Cs} were determined. Using these results, optimum pressures of Cs for any value of the interelectrode gap could be easily obtained. Calculations of maximum obtainable power for different values of T_K, T_α, d at electrode separations of d = 1 mm and 0.1 mm were carried out. The experimental results at d = 1 mm are in good agreement with calculations enabling one to confidently predict the maximum power at other values of the parameters. (auth)

10020 (CONF-720613-P3, pp 1177-1187) SINUSOIDAL POTENTIAL DISTRIBUTIONS AND VOLT-AMPERE CHARACTERISTICS OF KNUDSEN-MODE THERMIONIC EMISSION CONVERTERS. Kuznetsov, V. I.; Ender, A. Ya. (Ioffe Inst. of Physics and Tech., Leningrad). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In the Knudsen mode of operation in the absence of the potential well created by slow particles and at an internal potential drop close to zero, spatially oscillating or sinusoidal potential distributions are possible. It can be demonstrated that under these conditions a plateau region in which the plasma is quasi-neutral cannot exist. The effect of sinusoidal distributions on the shape of the volt-ampere characteristics of a thermionic converter is determined. It can be shown that several sinusoidal potential distributions, as well as several values of total current, can correspond to one anode potential. In order to construct accurate static volt-ampere characteristics, it is necessary to calculate the sinusoidal distributions numerically. This requires the solution of a system of one dimensional stationary Vlasov equations. A method for the numerical integration of such equations was developed which provided the capability of including a large range of parameters in the solution. It appeared that the volt ampere characteristics consist of a sequence of alternating regions with positive and negative internal resistance, i.e., it represents an S-shaped characteristic with a large number of branches. It is shown that such volt-ampere characteristics can excite oscillations at relatively low frequencies (the oscillation period is smaller than the traveling time of the ions over the interelectrode gap). Outside the region of sinusoidal potential distributions, the total current is determined in some cases by the virtual cathode. For such cases numerical results were obtained which permit the construction of volt-ampere characteristics of thermionic converters at any value of the compensation degree. (auth)

10021 (CONF-720613-P3, pp 1189-1198) EXPERIMENTAL INVESTIGATION OF THE IGNITED MODE OF A Ba–Cs CONVERTER. Knauss, G. (Univ., Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The ignited mode of a thermionic converter containing barium and cesium plasma was experimentally investigated. A diode with plane electrodes with variable spacing was used. The electrode materials were polycrystalline tungsten (emitter) and tantalum (collector). The collector was surrounded by a guard ring to prevent sidewall currents. Special structural measures allowed the barium vapor to condense before reaching the alumina ceramics which were used to insulate electrically the collector from the emitter. The ceramics had no contact with barium, therefore, chemical attack of the ceramics by barium because of the high affinity of barium for oxygen was avoided. As a result, the working life of the converter was not affected and decomposition products which could influence the electrodes did not appear. The shape of the current density (j)–output voltage (U)–curves of the Ba–Cs–diode in the ignited mode region is similar to that of the Cs-diode: An abrupt increase in current density when ignition takes place, followed by a "knee" and a smaller increase in current density when the output voltage becomes smaller. At $T_{Cs\text{-}Res.} < 500°K$ (electrode spacing 0.8 mm) the ignition voltage is in the negative power region and the extinguishing voltage in the positive or negative power region depending on the operating conditions. At $T_{Cs\text{-}Res.} \gtrsim 500°K$ (electrode spacing 0.8 mm) the ignition and extinguishing points coincide in the positive power region. The current densities in the ignited mode are one or two orders of magnitude greater than those in the unignited mode, e.g., $j = 100$ A/cm^2 at $T_E = 1991$ K, $T_{Ba\text{-}Res.} = 950°K$, $T_{Cs\text{-}Res.} = 460°K$, electrode spacing = 0.8 mm, whereas $j = 2$ A/cm^2 in the unignited mode. Electrical output power densities up to 10 W/cm^2 and higher are obtained. The j-U-characteristics show little or no dependence on spacing up to spacings of at least 1 mm at not too high or low cesium pressures. The measurement of the electric resistance and an examination with the scanning electron microscope and the electron beam-microscope analyzer showed that barium did not condense on the ceramics between the emitter and the collector, and that the ceramics was not chemically attacked. (auth)

10022 (CONF-720613-P3, pp 1199-1205) THEORETICAL CONSIDERATIONS ON CURRENT VOLTAGE CHARACTERISTICS

OF Ba–Cs CONVERTER. Schindler, M. (Univ., Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Due to the low pressure in diodes filled with Cs–Ba vapor mixture, the current voltage characteristics are essentially different from those usually known. These characteristics are discussed with regard to work function determination of the Ba covered emitter. Large discrepancies occur between the values obtained from unignited mode characteristics and those from arc mode characteristics. An attempt is made to explain these discrepancies by the anomalous Schottky-effect. (auth)

Refer also to abstracts 10677, 10773, 11417, 11857, 11949, 12125, 12415, and 12463.

10023 (CONF-720613-P3, pp 1207-1221) FUNCTION, FEATURES, AND LIMITATIONS OF Ba–Cs DIODES. Henne, R. (Institut fuer Energiewandlung und Elektrische Antriebe, Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The technology and the construction of a plane thermionic diode with variable spacing, with polycrystalline molybdenum electrodes working in a mixture of Ba- and Cs-vapor is described. Measurements over several hundred hours were made to determine the effect of several parameters like emitter-temperature in the range of 1700 to 2100°K, collector-temperature (900 to 1500°K), Ba-reservoir-temperature (700 to 1050°K), Cs-reservoir-temperature (400 to 600°K) and electrode spacing (0.05 to 2 mm). With these results it was tried to optimize this mixed-vapor-system, especially at larger spacings. The conditions and temperature regions at which such Ba–Cs-diodes are to be preferred are demonstrated by comparing them with features of Cs-diodes. The limitations of such a device are also shown. The possibility of a further gain of power density by using other electrodes is discussed. Particular interest is directed to the time behavior of these diodes and to the work function of the collector in the Ba–Cs-vapor mixture. The values of the collector work functions were calculated by the saturation back emission. By means of experiments, where Ba or Cs was introduced into the diode without the other vapor, the separated influences could be studied and conclusions for further investigations could be derived. By evaluations of the dependence of the current-voltage-characteristics on collector-temperature interesting results were obtained, which can give more knowledge about the role of the collector in the ion-production for space-charge neutralization. In the case of a Ba–Cs-mixture there exists at special conditions an observable increase of the current, depending on collector-temperature, which is more pronounced for Ba-vapor alone. (auth)

10024 (CONF-720613-P3, pp 1223-1232) SIMPLIFIED THERMIONIC CONVERTER CALCULATIONS. Hansen, L. K. (Atomics International Div., Canoga Park, CA). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A simplified method for making thermionic converter calculations is described which retains a correct analytical description of the essential phenomena in the converter, but approximates just enough to allow solutions to be obtained rather simply. These approximations include two assumptions, i.e., that the electron temperature distribution between the electrodes is linear with position and that the cesium plasma near the collector is in local thermodynamic equilibrium. Both assumptions agree with available experimental data. (LCL)

10025 (CONF-720613-P3, pp 1233-1243) MAXIMUM ATTAINABLE EFFICIENCY OF THERMIONIC CONVERTERS. Urbaniec, K. (Technical Univ., Warsaw). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A numerical analysis is made of the overall efficiency of ideal thermionic converters in order to evaluate their feasibility for use in commercial power generation. The variables investigated included emitter temperature, collector work function, cesium vapor temperature, and electrode emissivities. (LCL)

10026 (CONF-720613-P3, pp 1245-1254) THEORETICAL DETERMINATION OF THE PERFORMANCES OF A CONSTANT-INLET POWER CONVERTER. Alleau, T. (CEN, Saclay, France). 1972. (In French).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In the framework of the study of the thermoelectronic reactor project it was necessary to have available an analytical model of the converter. The SIMCON calculation code was used. The improvement and use of this program, modified and adapted to the particular problems of converter performances, is described. The modified code is then applied to coupled diode systems inside a reactor. The effect of five parameters (the output work of the plain emitter, inhomogeneity of the flux distribution of the emitter, Cs temperature, emissivity of the collector and emitter, and the interelectrode distance) was determined theoretically. The results showed that a variation of 25% of the thermal flux available along the emitter does not perturb the performances of the converter. It is preferable, for a homogeneous thermal flux, to operate at a Cs pressure slightly too high. Deterioration of the diode performance can result if the preparation of the electrode surface is neglected. At low thermal powers it is preferable to operate with significant interelectrode distances. (JSR)

10027 (CONF-720613-P3, pp 1255-1267) LOCAL THERMIONIC EMISSION FROM BARE AND COVERED SURFACES OF CERMET ELECTRODES. Schmidt, D.; Ondracek, G. (Institut fuer Energiewandlung und Elektrische Antriebe, Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The emission properties of cermet electrodes consisting of a rigid metal sponge with ceramic material in the pores and of ordinary metal-covered cermet electrodes are compared using images obtained by electron emission microscopy and by test data on emission currents. The bare, or sponge-type, cermet electrodes were found to have higher emission current density and homogeneity, greater geometrical stability, and more resistance to ion and chemical attack. (LCL)

10028 (CONF-720613-P3, pp 1279-1288) I-V-CHARACTERISTICS OF A CONVERTER WITH A NONISOTHERMIC OR ISOTHERMIC EMITTER AND 5 COLLECTORS. Vetter, H.; Froehlich, G.; Mayer, R. (Univ., Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A cylindrical cesium converter with a unique emitter (Ta or Re) and 5 electrically insulated collectors (Nb) was built. The emitter can be made to assume different temperature profiles. The total volt-ampere characteristics can be measured with this converter. The measurements were for a range of temperatures T_E = 1500 to 2000°K, T_R = 547 to 634°K, T_C = 820° ± 30°K and electrode spacing d = 0.45 mm (Ta) and d = 0.3 mm (Re). The following properties of the converter have been determined from the volt-ampere curve: emitter work function, ignition voltage and the electrical power (for various profiles of the emitter temperature) as a function of cesium pressure. (auth)

10029 (CONF-720613-P3, pp 1289-1299) I-V-CHARACTERISTICS OF A PLANE PARALLEL CESIUM DIODE WITH TANTALUM AND TUNGSTEN EMITTER. Maier, E.; Froehlich, G.; Mayer, R. (Univ., Stuttgart). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Measurements of volt-ampere characteristics of a plane parallel cesium diode operated both in the unignited and ignited modes have been obtained. The emitter temperature ranged from T_E = 1700°K to 1900°K, the cesium pressure from p = 0.1 torr to 6.0 torr and the electrode spacing from d = 0.2 mm to 1 mm. A pure tantalum emitter and a CVD-tungsten emitter were used. The unignited mode characteristics were recorded because this enables the determination of the emitter work function of the chosen materials from the saturation current for the respective cesium coverage. Since the materials used (Ta and W) are polycrystalline the electron emission surface consists of patches with different work functions. From the measured saturation current, an effective work function is obtained. The volt-ampere characteristics in the ignited mode were calculated using the respective parameters of the experiment and compared with the characteristics obtained experimentally. The change in the shape of the volt-ampere characteristics due to the variation of cesium pressure, electrode spacing and emitter temperature are also discussed. The stability of the output voltage of the diode was investigated for a change of the current drawn (a change in the diode load resistance). This investigation was made at the operating point of maximum power generation for various Cs-pressures, electrode spacings and emitter temperatures. (auth)

10030 (CONF-720613-P3, pp 1455-1469) SOME CONSIDERATIONS ON THE CESIUM LOW-VOLTAGE ARC IN A

THERMIONIC CONVERTER. Bohdansky, J. (CCR-EURATOM, Ispra, Italy). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The discharge conditions in a Cs diode near the inflection point are investigated. The discussion is based on a two zone model where both energy and current transport are considered. The dependence of maintenance voltage and current on various discharge parameters is discussed. According to this model the transition from saturation mode to obstructed mode is not necessarily connected with an emitter double sheath. Limitations in energy transport (large spacing) or ion transport (close spacing) may cause this phenomena. It is indicated that the maintenance voltage can also be influenced by the minimum collector sheath potential or by the electron to ion mean free path ratio. Both quantities are possibly influenced by the collector temperature. (auth)

10031 (CONF-720613-P3, pp 1471-1486) INFLUENCE OF THE CURRENT DEPENDENCE OF THE ELECTRON TEMPERATURE ON THE SHAPE OF THE VOLT-AMPERE CHARACTERISTIC. Shcherbinin, P. P. (F.E.I., Obninsk, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The initial stages of the arc discharge are analyzed. The contemporary state of the theory of the negative section of the volt-ampere characteristic (VACH) and the understanding of the causes of hysteresis are reviewed. The possibility of obtaining an analytical description of the transition from the diffusion to the arc mode is investigated, with the assumption that the electron temperature, T_e, is not constant along the VACH. Initially, the mode without volume ionization was investigated. In this case, at the small degree of surface ionization, ω, on the VACH plateau, the electron temperature is near the atom temperature, but increases without limit with increasing ω. The role of the volume ionization increases with the temperature of the electrons. A consideration of volume ionization does not change the asymptotic character of the diffusion section of the VACH at small ω. However, a second branch of the VACH arises which passes at a higher level some distance from the diffusion branch. With large values of ω, T_e becomes high enough to provide a substantial increase in the conductivity in the presence of volume ionization, and both VACH branches will coincide. Consequently, the section having a negative resistance at increasing ω will disappear and the near-electrode bounds along the VACH will not change sign. Experimental data and numerical calculations of other authors are compared. The possibility of using the proposed mathematical model for describing hysteresis is discussed. (auth)

10032 (CONF-720613-P3, pp 1487-1501) NONLINEAR CURRENT OSCILLATIONS IN A PLASMA DIODE. Zherebtsov, V. A.; Shut'ko, A. V. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

It is known that low-frequency current oscillations are observed in some regimes of the thermionic converter. Linear theories of such oscillations have been the subject of numerous recent papers. However, the linear consideration is restricted by the limit of infinitesimal amplitudes. Nonlinear oscillations are examined in the regimes of a high cathode temperature and low cesium pressure when coulomb collisions phy a major role in producing the oscillations. It is shown that stationary ion-acoustic oscillations may exist in a plasma diode when an ion sheath is formed on the cathode. Amplitude stabilization is determined by the energy dissipation of the high harmonics because of the ion viscosity. The critical value of a characteristic nondimensional parameter of our problem is calculated. When the parameter is raised only slightly above the critical value a stationary current-oscillations intensity is obtained and the effect of finite-amplitude oscillations on the mean current is analyzed. In addition transition processes are discussed. (auth)

10033 (CONF-720613-P3, pp 1503-1516) INSTABILITY AND CONTRACTION OF CURRENT IN A THERMIONIC CONVERTER. Abramov, Yu.; Gladush, G. (Inst. of Atomic Energy, Moscow). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

As known, the transition from the diffusion mode to the arc mode at low emitter temperatures is accompanied by an anode glow and a contraction with the consistent expansion of the current cord. Perhaps these phenomena are connected with the inhomogeneity of the volt-ampere curve of the converter. It is necessary to determine the cause of it and to generate the ideal volt-ampere curve, that is, the calculated one assuming homogeneity of the discharge along the electrodes. Then it is necessary to investigate the stability of this state with respect to the inhomogeneity along the electrode. The calculation is produced by the model described below. It is supposed that the ionization starts close to the anode and that the region of the ionization expands with increasing current. The interelectrode gap consists of two regions: the ignition anode region and the diffusion cathode region; there is no volume ionization in the last region. The electron space charge is neutralized by the ions from the ignition region. There is a large current region with negative differential resistance of the volt-ampere curve calculated by this model. It was shown that the plasma state is not steady in this case. It is possible to deduce from a linear consideration that the plasma is divided in two regions along the electrodes with a high and low current value. (auth)

10034 (CONF-720613-P3, pp 1517-1528) DISCHARGE INSTABILITY IN THERMIONIC CONVERTERS WITH LONG ELECTRODES. Derbilov, V. I.; Karetnikov, D. V.; Turundaevskii, V. B. (Inst. of Atomic Energy, Moscow). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

An original thermionic diode with long electrodes has been built for simultaneous measuring plasma and current density distributions along the electrodes. The plasma and current density distributions in such a diode are sometimes essentially nonuniform (usually striated) even in the case of a nearly uniform distribution of the emitter temperature. This phenomenon seems to account for increasing instability. The nonuniformities show up most clearly when the diode emission current density approaches its maximum. Contributions to the instability may be from discharge contraction (volume diffusion), nonuniform coverage (surface diffusion), emitter temperature profile variations (electron cooling). The dominant process can be determined by measuring increments and time responses of plasma densities in rapid and step change of the current. The analysis shows that the response time is highest when the temperature profile change takes place, and is about some tenths of a second. The response time was measured by comparing differences in the discharge glow distributions. The stable plasma and current density distributions were also taken into account. From the results of these measurements it can be seen that all peculiarities of the distributions occurring in a time interval much shorter than 0.1 s and, hence, the thermal profile redistribution cannot account for the instability. In the operating conditions of the converter close to the optimum output the current density distribution corresponds qualitatively to the initial temperature profile of the emitter (no instability) if the Joule losses on the electrodes are negligible. (auth)

10035 (CONF-720613-P3, pp 1529-1545) INFLUENCE OF A NONEQUILIBRIUM ELECTRON DISTRIBUTION FUNCTION NEAR THE CATHODE AND FRACTIONAL COVERAGE ON THE CHARACTERISTICS OF A THERMIONIC EMISSION CONVERTER IN THE ARC MODE. Baksht, F. G.; Korobova, I. L.; Moizhes, B. Ya. 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The injection of fast electrons from the cathode into the plasma and their emission from the plasma at the cathode may result in a non-Maxwellian distribution for the high-energy electrons in the cathode boundary layer of the low voltage arc in a thermionic converter. This affects the magnitude of the current transported by the electrons at the cathode boundary of the plasma and the ionization rate of atoms in the cathode boundary layer. The influence of these two effects on the calculated volt-ampere characteristics of a converter is considered. To determine the ionization rate of the atoms, accounting for the non-Maxwellian character of the electron distribution function at the cathode the fully developed discharge mode was considered for the case in which the potential drop near the cathode is close to the resonance level excitation potential of the cesium atom. In this case, the non-Maxwellian character of the distribution function affects mainly the excitation rate of the resonance level of the atoms, and only weakly the transitions between the excited states. Calculations of the plasma parameters were made allowing for and neglecting the nonequilibrium ionization mechanism. It appears that the nonequilibrium ionization mechanism does not particularly af-

fect the plasma parameters and the output voltage of the converter, since in a developed discharge, the injected beam quickly relaxes as a result of interelectron collisions, while the consideration of an additional ionization mechanism is compensated for by a slight change in the electron temperature and the ionization rate under the action of Maxwellized electrons. If the cathode emission rate is determined by the fractional coverage of the cathode with cesium, then in the calculation of the volt-ampere characteristics of the converter it is very important to take variation of the fractional coverage with operation mode into consideration. In most cases, the increased current passing through the converter in the arc mode will lead to decrease in the total flux of atoms and ions to the cathode. The fundamental cause of this phenomenon is the increase of the electron pressure in the cathode boundary region and the corresponding decrease in the concentration of heavy particles at the cathode. If the work function is determined from data obtained at lower cesium vapor pressures, then it is necessary to also take into consideration the variation in the stream of atoms to the cathode during the transition from a Knudsen gas between the electrodes to a dense gas. (auth)

10036 (CONF-720613-P3, pp 1547-1562) NONEQUILIBRIUM RELAXATION PHENOMENA IN THE NEAR-EMITTER REGION OF THE THERMIONIC CONVERTER. Shaw, D. T. (State Univ. of New York, Buffalo). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The electron energy distribution function in the near-emitter region of an ignited thermionic converter was investigated both theoretically and experimentally. The spatially dependent Boltzmann equation with the electric field and collision terms is solved numerically for a steady-state cesium plasma. The collision terms include the elastic, inelastic, and electron–electron Coulomb collisions. The Fokker-Planck approximation of Coulomb collision is used. Experimental measurements were carried out in a cesium discharge tube based on second harmonic method. Good agreement is found between the theory and the experiment. (auth)

10037 (CONF-720613-P3, pp 1563-1574) MODEL IMPROVEMENTS FOR THERMIONIC DIODE PLASMAS. Claassen, H. A.; Helrich, C. S. (Kernforschungsanlage, Juelich, Ger.). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In order to make definite recommendations for model improvements for short spaced diodes operating in the arc mode, the phenomena affecting the deviations from translational and internal plasma equilibrium of such diodes were analyzed. In particular, the following were studied: the test particle problem for momentum and energy exchange from electron beams entering the plasma body, collision dominance of the heavy plasma species, influence of unbalanced inelastic collisions on the high-energy tail of the electron distribution function, importance of radiation escape and excitation diffusion on the particle balance equations for the lower states of the cesium atom. (auth)

10038 (CONF-720613-P3, pp 1575-1585) THERMODYNAMIC PROPERTIES OF Cs VAPORS. Reiter, F. W. (EURATOM, Ispra, Italy). 1972.

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

By means of the statistical theory the thermodynamic functions, e.g., Gibbs function, enthalpy, entropy and molar heat at constant pressure and the composition of Cs vapors are calculated in the temperature range from 298.15 to 10000°K and the pressure range from 10^{-5} to 10 atm. It is presumed that the vapors are composed of diatomic molecules, atoms, simply charged ions, and electrons and that they are in thermodynamic equilibrium. To calculate the contribution of the molecules to the thermodynamic functions, in the state sum of the molecules the electronic ground state and the 4 lowest excited states are considered, which by decay lead to one atom in the ground state and one atom in the first excited state. As at higher temperatures ionization is almost complete. In the partition function of the atoms a summation has to be done over all excited electronic states up to a characteristic principal quantum number which marks the highest excited state before the ionization limit. This quantum number is calculated from ion density by an iterative method. As the ion density depends on temperature and pressure, also the characteristic principal quantum number and the thermodynamic functions are depending on temperature and pressure. The molar heat at constant pressure of Cs vapors therefore has at higher temperatures a maximum which is shifted with decreasing pressure to lower temperatures and whose value increases. The composition of the Cs plasma is calculated from the Gibbs functions of the components with simultaneous consideration of dissociation and ionization. The thermodynamic functions of Cs vapors, which can be calculated from the composition of the plasma and the partition functions of the components, are discussed and compared with results found by approximative methods. (auth)

10039 (CONF-720613-P3, pp 1587-1622) PLASMA DIAGNOSTICS IN THERMOEMISSION CONVERTERS. (Review). Dyuzhev, G. A.; Yur'ev, V. G. 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Plasma diagnostics in thermoemission converters are reviewed. The basic methods of plasma diagnostics, i.e., the probe and the optical methods, are described. Under optical methods the determination of the concentration of electrons and ions, determination of electron temperature, and determination of concentration of atoms are considered. A comparison is made of probe and optical methods with respect to the calculation of the electron current and calculation of the ion current and the generation function. Other methods are briefly discussed. Surface diagnostics in thermionic converters are discussed with a consideration of the determination of the work function of the cathode, determination of the degree of mottling of the cathode, virtual cathodes, and virtual anodes. (48 references) (JSR)

10040 (CONF-720613-P3, pp 1623-1642) SOME PHYSICAL PROPERTIES OF PLASMA DIODES. Morgulis, N. D.; Levitskii, S. M. (Kiev State Univ.). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

An investigation of some physical processes occurring in short discharge plasma diodes, which are physical models of thermionic energy converters, was carried out in various regimes. Because of the nature of the ionization and recombination occurring in a cesium plasma diode working in the arc mode, these investigations dealt with the properties and parameters of such a plasma under the influence of resonance radiation from an external cesium flow and charge recombination in the plasma volume and on the surface of the electrodes, and electron cooling during the process of plasma decay. It was shown that under special conditions, a significant increase in irreversible processes may occur on the electrode surfaces of a short diode. An example of such processes is the deexcitation of cesium atoms from the 6P resonance level which is very important for stepwise ionization and charge recombination. Therefore, the arc discharge in the short diode should be somewhat inhibited compared to the common long cesium discharge under the same experimental conditions. This may affect both the corresponding increase of specific power input to the plasma and the electron temperature necessary to maintain a given charge density as well as the case with which a local thermodynamic equilibrium is established in such a short diode. Because of the nature of the microwave processes occurring in a cesium or mercury plasma diode in the direct flow regime, the properties of the electromagnetic radiation were considered. This radiation is emitted when microwave oscillations are taking place in the diode. Generally the radiation spectrum can be shown to correspond to the spectrum of microwave oscillations occurring within the diode and contains frequencies in the range from 2000 to 4000 MHz. The radiation is polarized along the E vector parallel to the diode axes. For small interelectrode spacings, the diagram of the Poynting vector is similar to the dipole case and is determined by the radiation diffraction on the electrodes. At greater spacings, this diagram acquires a maximum directed toward the cathode. The integral of the radiation power is approximately 10^{-6} times the electron flow power. The immersion of the diode into an external plasma or the modulation of the electron flow by a monochromatic microwave signal does not change the form of the Poynting vector diagram, but increases greatly the radiation power. It is believed that the source of such radiation is the transformation of plasma waves into electromagnetic waves on plasma inhomogeneities existing over the cathode. (auth)

10041 (CONF-720613-P3, pp 1643-1660) EXCITATION AND IONIZATION PROCESSES IN A LOW-VOLTAGE ARC DISCHARGE. Lebedev, M. A.; Mayev, S. A.; Morozova, G. G.; Privalov, I. N. (Inst. of Power Engineering, Obninsk, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The results of the investigation of the cesium plasma in a low-

voltage arc discharge in the pressure range from 0.1 to 2.0 torr and current densities of from 0.6 to 5.0 A/cm^2 are presented. By means of spectroscopic methods for plasma diagnostics, electron temperature and density (T_e,η_e) and population of the excited states (Ni) of the Cs atom were measured. It was found that at $\eta_e \geq 10^{14}$ cm^{-3} and pressures of the Cs atoms $p \geq 1$ torr the cesium plasma is in a state of local thermodynamic equilibrium (LTE), and its parameters may be found with the help of Saha's and Boltzmann's equations with $T = T_e$. By lowering $\eta_e$or p LTE is destroyed. It was found that in the distribution of the electrons over the excited levels three separate regions are developing, each having its own distribution temperature T. These regions are called "blocks". The lower levels (E_{ex} = 3.34 eV) have, as by LTE, the electron temperature: $T_r = T_e$; the levels of the second block (E_{ex} = 3.34 to 3.72 eV) have a distribution temperature T_r which is approximately equal to the atom temperature T_a, and the distribution temperature of the upper levels is much lower than T_a. The existence of such blocks of levels can be explained by different mechanisms of excitation and ionization. The population of the levels of the lower block is due to electron collisions, the second block is populated by the atom–atom collisions, the upper block is built up due to the phenomenon of autoionization, which is confirmed by the shift of the "head" of the recombination spectrum to the red. By the extrapolation of the Boltzmann line for the lower levels to the energy $E_{ex} = 0$ the density of the ground state atoms in the interelectrode space was found. This density decreases with increasing discharge current, which can be explained neither by the heating of the neutral gas, nor by the ionization of the cesium atoms. (auth)

10042 (CONF-720613-P3, pp 1661-1674) MAXWELLIZATION OF ELECTRONS IN Cs PLASMA OF A LOW-VOLTAGE ARC DISCHARGE. Gus'kov, Yu. K.; Kiryushchenko, A. I.; Lebedev, M. A.; Cherkovets, V. E. (Inst. of Power Engineering, Obninsk, USSR). 1972. (In Russian).

From 3rd international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The results of a quantitative comparison between the calculated Maxwellization of the electron distribution function in the precathode area of a low-voltage arc discharge and that obtained in the experiment are reported. The distribution function along the velocity component V_z, normal to the surface of the cathode, was measured with a plane Langmuir probe inserted into the diode through the anode. Measurements were made at different distances x from the cathode. The theoretical and experimental results were in good agreement. (LCL)

10043 (CONF-720613-P3, pp 1675-1698) POLARIZATION AND INTERFEROMETRIC INVESTIGATIONS OF DISCHARGE MODES IN THERMIONIC CONVERTERS. Busygin, E. P.; Grigor'yants, V. G.; Dunaev, Yu. A.; Serov, Yu. L.; Yavor, I. P. (Ioffe Inst. of Physics and Tech., Leningrad). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Results of experimental investigations of discharge modes in Cs filled thermionic energy converters are presented. The investigations were carried out over a large range of Cs vapor pressures from the Knudsen arc (10^{-2} torr) to the dense arc mode (10 torr). Optical methods of measurement were employed for the first time under the conditions encountered in thermionic energy converters. The results of an investigation of the polarization of the spectral line emission from Cs in a Knudsen arc are given. The polarization rate provides information regarding the plasma nonequilibrium. In the short Knudsen arc, the role of the Maxwellian electrons in the excitation of atoms may be unimportant in comparison to the excitation by oriented electrons. Under these conditions, the discharge emission will be polarized with the degree of polarization depending on the discharge mode. The effect of a longitudinal magnetic field on the polarization rate was analyzed. This greatly depended on the populations of the spin states. Under the conditions studied here, the magnetic field caused an increase in the polarization rate. The polarization rate was also found to depend on the energy of the excitation electrons. The conditions under which the emission of the Knudsen discharge is polarized are analyzed and discussed in detail. The results of measurements of the concentration of Cs atoms in the gap of a flat thermionic converter using the Hook method are presented. The measurements were performed under vapor pressures of from 10^{-2} torr to 10 torr, cathode temperatures from 1000 to 2000°K, and interelectrode gaps from 0.2 to 2 mm. The distribution of atom concentrations across the gap of the converter and the variations of these distributions with mode variations were determined. The measurements were carried out using interferometry which provides a higher precision in the determination of relative variations. Variations of the distribution profile in the gap as well as considerable absolute variations of the concentration of Cs atoms were detected by their relationship to the current passing through the gap. The populations of the 6 P-level were determined by the Hook-method at Cs vapor pressures of about 10 torr and currents of 10 A. By interferometry it was possible to directly determine the atom concentration in the gap of the working converter to a precision of within a few percent. Several essential details regarding the application of this method to thermionic energy converters are given. (auth)

10044 (CONF-720613-P3, pp 1699-1719) ARC MODE THERMIONIC CONVERTER AT LOW CESIUM VAPOR PRESSURES. Dyuzhev, G. A.; Kucherov, R. Ya.; Moizhes, B. Ya.; Yur'ev, V. G. 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Work carried out in the Soviet Union during the period 1968 to 1971 on the properties of a plasma in a low-voltage discharge thermionic converter at low Cs vapor pressure. This work involved the simultaneous study of the volt-ampere characteristics of the converter and the probe as well as the spectral characteristics of the discharge plasma. Data on the distribution of the plasma density, temperature, and potential were obtained, from which conclusions regarding the mechanisms providing for the scattering of the emitted, current-carrying electrons, and of the ionization in the discharge at low cesium vapor pressure were drawn. An investigation into the influence of the addition of noble gases into the interelectrode space on the discharge parameters showed that a positive effect is obtained only at Cs vapor pressures under 0.1 mm of Hg, when the losses connected with the escape of ions to the electrodes are essential. (auth)

10045 (CONF-720613-P3, pp 1721-1738) INVESTIGATION OF TRANSIENT PRESSURES IN THE PLASMA OF A THERMIONIC EMISSION CONVERTER. Kaplan, V. B.; Martsinovskii, A. M.; Tsirkel, B. I.; Yur'ev, V. G. 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Transient processes in a thermionic converter were investigated at ignition and quenching of the arc and during the transition from one arc mode to another. The investigations were made by pulsing the anode with a square wave having a steep (~0.1 μs) front and decay. The basic measurements were performed by optical means using an integrator with a time resolution of ~20 ns to record the weak signals from the photomultiplier. The variation of the current and the distribution of plasma parameters across the gap were measured during delivery of the square potential pulse. Conclusions could be drawn regarding the velocity and peculiarities of the stepwise ionization under different conditions from the character of the increase in charge carriers and excited atom populations. Investigations of the arc ignition have shown that there are distinct development stages of the discharge with corresponding characteristic times. The dependencies of these stages on external parameters of the converter (cesium vapor pressure, interelectrode spacing, and emission rate) and on the supplied potential have been determined. The plasma production process and the alterations in the plasma at different stages of the arc formation have been investigated. The ion generation mechanisms have been investigated in correspondence to the discharge development. In investigating the quenching, characteristic decay times of the concentration and of the discharge current were determined. It has been shown that under conditions to be found in a thermionic converter, ambipolar diffusion plays a decisive role in neutralization of the plasma, while recombination is only essential at high (~10^{+14} cm^{-3}) concentrations. (auth)

10046 (CONF-720613-P3, pp 1747-1760) UNIFORM THEORY OF PLASMA AND ITS SHEATHS IN THE THERMIONIC DIODE. Daybelge, U. (Ruhr-Univ., Bochum, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A transport theory for thermionic converters is suggested which avoids artificial division of the interelectrode space into various regions such as sheath, space charge, and plasma regions. Instead of patching separate solutions for such regions, a matched-asymptotic analysis provides a uniformly valid solution for the whole region. The theory incorporates the interaction of the gas and the electrode surfaces and yields the dependence of macroscopic variables upon the microscopic boundary conditions. In order to develop a mathematical tool a simplified model is first considered. (auth)

10047 (CONF-720613-P3, pp 1761-1772) IGNITED MODE OF CESIUM THERMIONIC DIODE. II. The Charge Influence on the Volt-Ampere Characteristics. Musa, G.; Popescu, A.; Niculescu, N.; Blatog, A.; Mustata, I. (Inst. of Physics, Bucharest). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Experiments were performed to investigate the relation between electrical charges and the volt-ampere characteristics of the ignited cesium diode. Measurements were made to determine the influence of positive charges and added noble gases on the volt-ampere characteristics; relaxation time of perturbed volt-ampere characteristics; diffused electronic and ionic current through the grid type anode; and mobility of short pulse discharge-produced Cs ions. It was concluded that experimental results obtained from the measurements using a grid type anode and an electron and ion detection system can be useful for the study of the ignited mode of operation of the Cs plasma diode. The results are especially important in providing knowledge of the physical processes in the anode glow, detached anode glow, and ball-of-fire mode of ignited Cs diode. (LCL)

10048 (CONF-720613-P3, pp 1773-1777) IONIZATION OF MERCURY VAPOR AND CESIUM VAPOR IN A NUCLEAR REACTOR. Kramar, J. (Research Inst. of Electrical Engineering, Bechovice, Czech.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The radiation effects in a nuclear reactor on electrical current in a mercury discharge tube with a cold molybdenum cathode as well as in a cesium discharge tube with a hot tungsten cathode were investigated experimentally. In the former case the voltage in the discharge tube reached 200 V and radiation effects were observed. A post-experiment analysis assumed this was due to volume ionization of the mercury vapor. In the second case the voltage on the discharge tube reached only 5 V and no radiation effects on tube current were observed. Based on information obtained from experiments, this effect should not be observed in a thermionic energy converter under normal operating conditions. (auth)

10049 (GA-9526) TEST OF A THERMIONIC CONVERTER WITH A GRAPHITE SORPTION CESIUM RESERVOIR. Fitzpatrick, G. O.; Yates, M. K. (Gulf General Atomic Co., San Diego, Calif. (USA)). Mar 1970. Contract AT(04-3)-167. 68p. Dep. NTIS $5.50.

Declassified 5 Jun 1973.

A cylindrical thermionic converter designated Mark VIIA OC-A4 has been tested out-of-pile to determine its performance characteristics using both liquid cesium and graphite reservoirs and to study the long-term stability of a graphite reservoir-converter combination. The converter is still on test and has exceeded 3700 hours of stable operation at an emitter temperature of 1760°C, current density of 10 amps/cm^2, and an electrode power density of 7 watts/cm^2. The converter efficiency has remained constant within 3% during the steady-state operation and the operating temperature of the graphite reservoir is within 10°C of its initial value of 805°C. (auth)

10050 (KFK-1870) INVESTIGATION OF Cs-PLASMA DIODES BY IRRADIATION WITH LIGHT. Karow, H. U. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1973. 99p. (In German). Dep. NTIS (U.S. Sales Only) $7.00.

In Cs-plasma diodes with 1 to 2 mm electrode spacing, additional volume ionization was achieved for the first time in a defined manner by irradiation with laser light. The resulting rise of the power output of the thermionic converter was measured. The light power absorbed for the additional ionization was evaluated theoretically, using spectroscopically measured Cs-plasma densities and a kinetic Cs-plasma model obtained by other authors. As demonstrated for some practical cases, this technique ("active optical diagnostics") also allows the evaluation of important parameters and characteristics of thermionic converters with additional ionization. Furthermore, pulsed experiments at Cs-plasma diodes were performed with intense torroidal Xe-flash tubes with the light emitted onto the electrodes causing partial photodesorption of the Cs-film and thereby changing the work function. As shown by these experiments, it must be possible to change the work function of the emitter or collector independently of the other plasma diode parameters, which is useful for further optimization of the electrode parameters. (auth)

10051 MHD GENERATOR ON NONEQUILIBRIUM PLASMA CREATED BY VHF IONIZATION. Motornenko, A. P.; Belousov, E. V.; Boev, A. G. (Inst. of Radio Physics and Electronics, Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 6, 1007-1011(Jun 1973). (In Russian).

A hypoacoustic MHD-generator model was investigated on a highly non-equilibrium plasma obtained in the gas VHF-discharge under a pressure of 8 torr and the value for the Hall parameters $\beta = 5.1$. The scalar conductivity of σ and the concentration of electrons n_e estimated by VA characteristic is $\sigma = 97 \frac{mo}{m}$, $n_e = 10^{19} m^{-3}$, respectively. The gas temperature does not exceed 400°K. A number of dependences related to gas ionization peculiarities in MHD-generator are found. (auth)

10052 FUEL CELL GAS DIFFUSION ELECTRODES. Radovici, O.; Mavrodin-Tarabic, M.; Onaca, I.; Solacolu, I. Int. Chem. Eng.; 13: No. 4, 597-611(Oct 1973).

The main problems related to the development, structure, and mode of operation of gas diffusion electrodes are reviewed. (TFD)

10053 HIGH-EFFICIENCY CONVERTER AND BATTERY CHARGER FOR AN RTG POWER SOURCE. Donovan, R. L. (Martin Marietta Aerospace, Denver). pp 46-57 of Power Electronics Specialists Conference. New York; Inst. of Electrical and Electronics Engineers, Inc. (1973).

From power electronics specialists conference; Pasadena, CA (11 Jun 1973).

Spacecraft power systems utilizing radioisotope thermoelectric generators (RTGs) as primary power sources present an uncommon set of requirements and limitations for interfacing dc-to-dc converters. A converter configuration is presented that complements these RTG characteristics. The circuit is a variation of the basic flyback regulator modified to provide input regulation. The converter has two isolated outputs. One output provides power directly to the spacecraft equipment, while the second is used for battery charging. Design problems addressed are noise generation in long cable lengths between the RTG source and the converter, regulation of the converter input to obtain maximum power transfer from the RTG to the equipment, and provision for two converter outputs while maintaining high efficiency with a simple design implementation. The design of a converter and battery charger used on the Viking Lander Capsule is presented as an illustration. (auth)

10054 PHYSICAL BASES OF THERMIONIC ENERGY CONVERSION. Stakhanov, I. P.; Stepanov, A. S.; Pashchenko, V. P.; Gus'kov, Yu. K. Moscow; Atomizdat (1973). 375p. (In Russian).

The physical processes occurring in a low-temperature weakly ionized plasma were studied. The structure of the electrode layer in the plasma is discussed, as well as the mechanism of ionization of atoms in the discharge and problems concerning the occurrence and stability of vibrations in a weakly ionized plasma. Methods of calculating the current-voltage characteristics of a gas discharge are described, and the calculation of the kinetic coefficients of a low-temperature three-component plasma in a magnetic field is discussed. Particular attention is paid to a study of a low-voltage arc discharge. The effect of various additives to cesium on the operation of a thermionic energy converter is also considered. (IAA)

10055 COMPARATIVE REVIEW OF SILICON AND THIN FILM SOLAR CELLS FOR SPACE APPLICATIONS. Mytton, R. J. (International Research and Development Co. Ltd., Newcastle Upon Tyne, Eng.). Phys. Technol.; 4: No. 2, 92-112(1973).

The progress of research aimed at improving silicon and thin film solar cells so as to withstand the rigors of the space environment is reviewed using as a basis the proceedings of the photovoltaic specialists conferences which have been held throughout the last decade. It is noted how throughout this period the thin film cell has constantly challenged the already established silicon cell as a future photovoltaic power source. The way in which one problem after another has been overcome in the thin film CdS cell is reviewed against the background of continuing progress in silicon cell technology. The present position with the two cells is also compared. It is shown that there is now no longer any major uncertainty in the long term stability of CdS cells and that meaningful comparisons can be made between silicon cells and CdS cells with end of life (5 years in synchronous orbit) efficiencies of 9.6% and 5.9%, respectively. The power-to-weight ratios of two typical array designs, one a concertina array and the other a roll-out array, are estimated. Improvements of the order of 40% in power to weight ratio are forecast for the CdS arrays. Finally, the manufacturing costs of the cells are briefly compared and it is concluded that CdS cells will be about one third of the price of silicon cells. Furthermore, it is considered that this cost differential will be maintained provided that the production engineering of both types is advanced in parallel. (auth)

Facilities and Equipment

Refer also to abstracts 11705, 11713, and 12378.

10056 (AAEC/LIB/BIB-402) VENTILATION SYSTEMS AND COMPONENTS IN NUCLEAR POWER PLANTS AND RADIOACTIVE LABORATORIES. Geue, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1973. 37p. Dep. NTIS (U.S. Sales Only) $4.00.

One hundred and thirty-five references taken from Nuclear Science Abstracts and Engineering Index are arranged alphabetically by author within each year. The period covered is 1962 through 1972. An abstract citation is given for each reference. (AU)

10057 (ANL-CT-73-28) BOUNDS FOR CREEP IN THICK SPHERICAL PRESSURE VESSELS. Edelstein, W. S.; Valentin, R. A. (Argonne National Lab., Ill. (USA)). Oct 1973. 14p. Dep. NTIS $3.00.

The creep of a hollow sphere subject to constant internal pressure is considered. A method is derived for obtaining a priori upper and lower bounds for the displacement of any point in the spherical body at any time. (TFP)

10058 (LMEC-73-11) STRESS CORROSION IN THE PUMP BEARING TEST FACILITY (PBTF) DURING SODIUM SYSTEM CLEANUP. Stearns, J. D.; Wiese, R. W. (Atomics International, Canoga Park, Calif. (USA). Liquid Metal Engineering Center). 15 Nov 1973. Contract AT(04-3)-700. 156p. AT.

On July 29, 1972, approximately 7 gal of oil leaked into the sodium system of the LMEC Pump Bearing Test Facility (PBTF) when a pump seal failed. The system was drained, but pockets of residual sodium-oil reaction products remained after draining. Since cost and schedule considerations were deemed to preclude complete disassembly of the system, the moist nitrogen technique was selected to remove the sodium-oil residue. Although a 250°F temperature limit was imposed on the process, which required almost 2 weeks to complete, temperature excursions over 300°F were employed to unblock plugged lines. Metallographic examination of selected piping immediately after steaming revealed stress corrosion cracking limited to a depth of less than 0.006 in. The cracking originated on the inside surfaces and was associated with a honing treatment incurred during fabrication of the piping. Subsequently, in December 1972 during reassembly of the system a routine helium leak check disclosed extensive stress corrosion cracks, penetrating the entire wall thickness near locations of residual stress (e.g., circumferential pipe welds and thermocouple pads). Valves, instrumentation, and other components which had been removed from the system and steam cleaned separately with a steam lance did not exhibit stress corrosion. The stress corrosion cracking was attributed to exposure to an aqueous caustic solution at temperatures in excess of 250°F for an extended period of time. (auth)

10059 (NRPB-R-12) CALIBRATION OF A MONSANTO CASCADE IMPACTOR WITH A MONODISPERSE AEROSOL. O'Connor, D. T. (National Radiological Protection Board, Harwell (UK)). Aug 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50. UK 50 pence.

The performance of a size selective air sampler, the Monsanto cascade impactor, modified for use as an instrument for sizing solid airborne particles in radon monitoring has been studied using monodisperse unit density spheres of methylene blue dye. A colorimetric method of assessing the collected aerosol was used in preference to the commonly used size-count method of calibration. Experimental data are presented with a description of the method of aerosol generation, mass determination, collection efficiency and wall losses. A three-stage and a two-stage arrangement of impactor are discussed and collection efficiency curves presented for the various stages. The performance of the two-stage version agrees closely with the performance predicted from the work of previous experimenters. (auth)

10060 STANDARD SPECIFICATION FOR SHEATHED ELECTRICAL RESISTANCE HEATERS, FOR NUCLEAR OR OTHER SPECIALIZED SERVICE. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 15p. (ASTM-E-420-71).

This specification presents the requirements for cylindrical, metal-sheathed, electrical resistance heaters with compacted mineral-oxide insulation for nuclear or other specialized service. The intended use of a sheathed heater in a specific nuclear or general application will require an evaluation by the purchaser of the compatibility of the heater assembly in the proposed application including the effects of the integrated neutron flux, temperature, and atmosphere on the properties of the materials of construction. Although this specification has been prepared specifically to detail requirements for heaters to be used in nuclear environments, this does not preclude its use for heaters required for laboratory or specialized commercial applications where conditions exceed normal service requirements. This specification does not include all possible specifications, standards, etc., for materials that may be used as sheathing, insulation, resistance wire, or conductor wire in nuclear environments. The requirements of this specification include only the austenitic stainless steels and nickel-based alloys for sheathing; magnesium oxide, aluminum oxide, or beryllium oxide for insulation; and nickel-chromium or iron-chromium-aluminum heater elements with or without low-resistance connecting wires. The intent of this specification is to present the requirements for heaters capable of operating at sheath temperatures and heat fluxes that will limit the maximum internal heater-element temperature to 1050°C. (auth)

10061 NEW HIGH INTENSITY ACOUSTICS LABORATORY AT RADBROKE HALL. Jones, E. A. C.; Cusick, G. S. (Nuclear Power Group Ltd., Knutsford, Eng.). Brit. Engine Tech. Rep.; 11: 35-40(1972).

An account is given of a high-intensity acoustics laboratory, designed to assist in the development of components able to resist the high intensity noise levels in Advanced Gas-Cooled Reactors. The problems involved are outlined and some of the techniques used in their study are discussed. The testing facilities in the new laboratory are available to industry. (UK)

10062 IMPROVEMENTS IN AND RELATING TO PIPE OR TUBE COUPLINGS. Dunham, C. E. (to Avica Equipment Ltd.). British Patent 1,331,426. 26 Sep 1973. Filed Date 6 Oct 1969. 4p.

A coupling is described for pipes or tubes having V-shaped flanges. It comprises a band having two or more links pivotally connected together, with the free ends of the band connected by a toggle fastener comprising a lever pivotally connected to one of the free ends through a link. The lever has a screw the foot of which engages the other free end of the band; alteration of the position of the screw adjusts the extent by which the toggle can draw the two free ends of the band together. It is thought that such a coupling would be particularly useful in nuclear plants where it is often important that after removal of a coupling it should be capable of replacement in a minimum amount of time. (UK)

Heat Transfer and Fluid Flow

Refer also to abstracts 10612, 10613, 11850, 11877, 12071, and 12148.

10063 (ANL-CT-73-12) SURVEY AND ANALYSIS OF SOME CURRENT MIXING-TEE STUDIES. Uherka, K. L. (Argonne National Lab., Ill. (USA)). Jul 1973. 61p. AT.

A survey of three current mixing-tee studies and their related literature indicates that water test models can be used to adequately simulate the dynamic characteristics related to turbulent mixing of liquid metals. On the other hand, thermal similitude criteria are only partially satisfied and thus temperatures measured in water models can only be correlated to a liquid metal prototype for the central core region of the mixing zone. The thermal boundary layers and chamber wall temperatures cannot be adequately simulated by water flow due to the fact that the Prandtl numbers for liquid metals are much less than those of water. The analysis also showed that current theoretical models for predicting the effectiveness of liquid metal mixing chambers leave much to be desired. Theoretical models are useful as a design tool, particularly for mixing chambers having irregular and complicated geometries. Thus, additional research in this area is vital if optimum mixing chamber designs are to be obtained by an approach other than trial and error. In general it is concluded that pipe tees and similar configurations have a relatively poor mixing effectiveness. Consequently, when two liquid metals at significantly different temperatures are mixed, excessive thermal stresses and eventual failure are a definite possibility. (auth)

10064 (CEA-CONF-2310) DETERMINATION OF THE CONDITIONS FOR THE HYDRODYNAMIC AND THERMAL FUNCTIONING OF INDUSTRIAL CIRCUITS CARRYING BOILING MIXTURES. Croix, J.; Fabrega, S. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 32p. (In French). (CONF-720686-2). Dep. NTIS (U. S. Sales Only) $3.75.

From European two-phase flow group meeting; Rome, Italy (6 Jun 1972).

The results of a study of the boiling of mixtures made in the region of low pressures (1 to 2 bars) and in conditions found in

industrial applications (diameter of 25 mm and length of the test section 3m) are reported. A calculation program HYSROMEL was written and adjusted on tests done with water–ethyl alcohol mixtures. This code makes it possible to calculate the operating conditions in each section of an industrial circuit (pressure, concentration of various constituents in each phase, and temperatures). The domain of hydrodynamic stability of the circuit was also determined. (tr-auth)

10065 (CEA-CONF-2363) CLASSIFICATION OF TWO-PHASE FLOW INSTABILITY PHENOMENA. Boure, J. A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Transfert et Conversion d'Energie). 1972. 5p. (CONF-720686-4). Dep. NTIS (U.S. Sales Only) $3.00.

From European two-phase flow group meeting; Rome, Italy (6 Jun 1972).

A proposed classification scheme for two-phase flow instability giving type, mechanism, and characteristics is presented. (TFD)

10066 (CEA-CONF-2364) HYDRODYNAMIC OSCILLATIONS IN PARALLEL-FED HEATING CHANNELS. Fabrega, S. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 10p. (CONF-730865-2). Dep. NTIS (U.S. Sales Only) $3.00.

From European two phase flow group meeting; Brussels, Belgium (4 Jun 1973).

A method to determine the conditions of marginal stability in the working of an assembly of heating channels in boiling conditions, fed in parallel by a pump is described. The instability considered is the onset of hydrodynamic oscillations. In the case of a single channel, linearized models exist, which predict the threshold of instability. These models, with simple modifications, can be used to treat the more general case of channels working in parallel, identical or not. (auth)

10067 (KFK-1860) TURBULENT HEAT TRANSFER TO HELIUM AND HYDROGEN IN HEATED TUBES IN THE PRESENCE OF LARGE AXIALLY INCREASING TEMPERATURE DIFFERENCES AND THE RESULTING TEMPERATURE PROFILE. Pfriem, H. J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1973. 168p. (In German). Dep. NTIS (U. S. Sales Only) $10.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The turbulent heat transfer characteristics for helium and hydrogen with large differences between the wall and the bulk gas temperature ($T_w - T_b$) are described. Experiments were conducted employing electrically heated cylindrical tubes convectively cooled on the inside with helium. The heat transfer in the form of $Nu/(Re^{0.8}\,Pr^{0.4})$ decreases with axially increasing temperature difference ($T_w - T_b$) and increases, if this difference decreases. Equations are proposed for axially increasing differences between the surface and bulk temperature. The gas properties were evaluated at the bulk temperature. Also, a power temperature profile across the tube is proposed of the form $T_w/T = B_i' (y^+)^{A'}$ s when there are large temperature differences ($T_w - T_b$). Using the above mentioned heat transfer measurements and integrating the continuity equation across the tube, the coefficients A_i' and B_i' were evaluated. For the case of an axially increasing difference ($T_w - T_b$), the B_i' can be formulated as $B_i' = 1.05\ (T_w/T_b)/\sqrt{1000\ q^+}$. Thus an approach is given for the temperature profile in the presence of large temperature differences which is difficult to measure. (auth)

10068 (LA-UR-73-1473) RECENT ADVANCES IN COMPUTATIONAL FLUID DYNAMICS. Butler, T. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 21p. (CONF-731202-1). Dep. NTIS $3.25.

From international symposium on computing methods in applied sciences and engineering; Rocquencourt, France (17 Dec 1973).

The use of high-speed computers has opened new frontiers for the analysis and understanding of the complex processes in multidimensional transient fluid dynamics. Phenomena, heretofore intractable by analytical approaches or either difficult or impossible to study by experimental means, can be investigated in detail by numerical approaches. One of the most common of the numerical approaches is to approximate the non-linear partial differential equations that govern the dynamics by finite difference equations and solve them algebraically using the computer. A number of different techniques have been devised to solve these difference equations. Two of the more successful and widely used methods for solving these difference equations are described: (1) the Marker and Cell (MAC) Method for incompressible flows with free surfaces, and (2) the Implicit Continuous-fluid Eulerian (ICE) Method that applies to flows that range from supersonic to the far subsonic regimes. In addition, some recent refinements and extensions to the basic methods are reviewed. However, no attempt is made to present detailed descriptions of the methods or their extensions; this is left to the references cited in the text. (auth)

10069 (RT/ING-(73)12) PRESSURE INFLUENCE ON BUNDLE TWO-PHASE FLOW PRESSURE DROPS. Marinelli, V.; Grillo, P. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 18 Jan 1973. 32p. (CONF-710606-21; CONF-710630-2). Dep. NTIS (U.S. Sales Only) $3.75.

From 17th annual meeting of the American Nuclear Society; Boston, Massachusetts, USA (13 Jun 1971).

Results of experiments on bundle pressure drop are presented and discussed. These are part of the research activities of the CNEN Plutonium Program in the field of bundle pressure drops. Measurements were performed in the Karmen loop at Studsvik. It is well known that system pressure strongly influences two-phase flow pressure drops. It is this influence which is investigated, obtaining data relating to the following coolant conditions: mass velocities between 1350 (1×10^6) and 2710 (2×10^6) kg/m^{2}sec (lb/hrft^2); steam quality between 2 and 20%; and pressure at 8, 15, 30 bars. The boiling water was in adiabatic-isothermal status. (auth)

10070 (SGAE-2176) STEADY HEAT TRANSFER IN A TUBE WITH TURBULENT FLOW. Schmidl, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Inst. fuer Reaktortechnik). Sep 1973. 36p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

A three dimensional analysis of the heat transfer in tubes with turbulent flow is given. With the Navier-Stokes and energy equations the velocity and temperature distribution in the flow are found. Also a new heat transfer law is derived and used together with the well known Stanton number to estimate the eddy diffusivity for heat transfer. (auth)

10071 (USIP-73-15) SOME INTEGRAL STUDIES OF AIR BUBBLES IN WATER DUCTS. Andersson, A. J. W. (Stockholm Univ. (Sweden). Fysiska Institutionen). Oct 1973. 33p. Dep. NTIS (U.S. Sales Only) $3.75.

In zero-power reactor physics experiments at Studsvik, water boiling has been simulated by introducing air bubbles through perforated plates in the bottom part of fuel assemblies. Some studies were undertaken in order to find out how the maximum void fraction is affected by some parameters. Among the conclusions drawn from these studies are: (1) surface density of holes strongly influences the void fraction. Maximum void fraction is obtained with 1 to 4 holes/cm^2 (20°C), the optimum value of surface density being dependent on the geometry of the volume above the holes; (2) the holes in the plate should be perfectly drilled with sharp edges; (3) a suitable hole diameter is about 0.5 mm; (4) the void fraction vs water temperature has a maximum value at about 10 to 15°C; (5) the pH-value does not affect the void fraction significantly; (6) decreasing surface tension increases the maximum void fraction but only slightly (up to 3 per cent void); (7) increasing viscosity increases the maximum void fraction relatively strongly (up to 14 per cent void); and (8) a void fraction of 45% seems to be an upper limit for pure water in relatively large ducts. With fuel pins a maximum of around 40% is likely. (auth)

10072 TRANSIENT MULTIPHASE MULTICOMPONENT FLOW IN POROUS MEDIA. Morrison, F. A. (Lawrence Livermore Lab., CA). Int. J. Heat Mass Transfer; 16: No. 12, 2331-2342 (Dec 1973).

A one-dimensional transient two-phase, two-component flow in a porous medium was investigated analytically. The flow is described by the use of a continuity equation for each component, a momentum equation for each phase, the first law of thermodynamics, state equations, and relations for the transport properties. Local thermodynamic equilibrium is assumed. The effects of condensation and evaporation are included. The analysis shows that the flow resulting from a step change in the state at the surface of a uniform semi-infinite porous medium may be described by a single variable, which is a simple function of position and time. Under other conditions, position and time must be separately specified to determine the state of the mixture. Results of calculations relevant to the flow of cavity gas following an underground nuclear explosion are given. (auth)

10073 DNB IN LIQUID METAL HEATED FORCED CONVECTION BOILING. France, D. M. (Argonne National Lab., TN). Int. J. Heat Mass Transfer; 16: No. 12, 2343-2354(Dec 1973).

An experimental program was performed to investigate departure from nucleate boiling (DNB) in a flow boiling system heated by a liquid metal flow. The boiling fluid, freon 12, was circulated vertically upward and was heated by countercurrent flowing mercury. Magnitudes and trends of the heat flux and quality at DNB were compared with data obtained on a similar experimental facility employing uniform electrical heating of the test section wall. The results show that at a given quality, the magnitude of the DNB heat flux is larger in the case of uniform electrical heating. This

result is not predicted by a DNB correlation based on data obtained from electrically heated test sections employing uniform and non-uniform axial heat flux distributions. It is demonstrated that the DNB phenomenon in a temperature controlled liquid metal heated system may not be well predicted from correlations based on data obtained from heat flux controlled electrically heated (uniformly or non-uniformly) systems. (auth)

10074 NUMERICAL APPROACH TO NON-SPHERICAL VAPOUR BUBBLE DYNAMICS. Guy, T. B.; Ledwidge, T. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Heat Mass Transfer; 16: No. 12, 2393-2406(Dec 1973).

An explicit finite difference analysis has been applied to the growth and collapse of a vapour bubble in subcooled water. It is assumed that only mass transfer across the liquid vapour interface is important and that heat transfer can be neglected. The results of this computational analysis are compared with experimental results from the literature and shown to be in good agreement at subcooled of 1 and 10°C. For these experimental conditions the analysis shows that the bubble grows in a roughly spherical fashion but collapses in highly non-spherical manner. (auth)

10075 HEAT TRANSFER AND PRESSURE DROP PERFORMANCE OF ROD BUNDLES ARRANGED IN SQUARE ARRAYS. Marek, J.; Maubach, K.; Rehme, K. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Heat Mass Transfer; 16: No. 12, 2215-2228(Dec 1973).

Results are reported of measurements of pressure drop and heat transfer performed on two rod bundles with 9 and 16 rods, respectively, in square arrays. The measurements were carried out with helium, for Reynolds numbers between 10^4 and 3×10^5. The rod bundles have a P/D ratio of 1.283 and were operated at heat fluxes of up to 160 W/cm and wall temperatures of up to 700°C. Pressure losses at the spacers and the circumferential temperature distribution were also measured. The new results and available data from the literature were used to elaborate relations for pressure drop and heat transfer in rod bundles with rods arranged in square arrays. (auth)

10076 THERMAL DIFFUSION IN TURBULENT WATER FLOW WITH GAS BUBBLES. Bobkov, V. P.; Ibragimov, M. Kh.; Tychinskii, N. A.; Fedotovskii, V. S. Int. Chem. Eng.; 13: No. 4, 687-692(Oct 1973).

Experimental determination of mean temperature fields and heat-transfer coefficients in gas-liquid flow through circular tubes of various diameters is presented. Systems investigated include water-gas and mercury-gas mixtures. (auth)

10077 NUMERICAL MODEL OF HEAT TRANSFER IN A ROD BUNDLE WITH HELICAL WIRE WRAP SPACERS. Graves, A. W. (Atomics International, Canoga Park, CA); Catton, I. J. Heat Transfer; 95: No. 4, 559-562(Nov 1973).

A practical solution to the problem of predicting operating temperatures for nuclear fuel assemblies containing wire-wrapped fuel pins spaced in a triangular array is presented. It is shown that the flow field predictions for the subpitch length (below 12 in. for these data) agree with experimental data obtained from prototypic LMFBR model fuel assembly tests. (auth)

10078 EFFECT OF OBSTACLES ON A LIQUID FILM. Shiralkar, B. S.; Lahey, R. T. Jr. (General Electric Co., San Jose, CA). J. Heat Transfer; 95: No. 4, 528-533(Nov 1973).

It has been observed in simulated nuclear reactor critical heat flux (CHF) experiments that CHF tends to occur upstream of flow obstructions, such as grid type spacers. An experimental program was conducted to quantify the effect of various obstacles on a liquid film. Although this was an adiabatic (air-water) study, a phenomenological mechanism causing dryout was observed. A simplified analysis of the observed phenomena has indicated that, above a critical Weber number, the ratio of the moments of the liquid and vapor streams is the important parameter in determining when an upstream dry patch will form. (auth)

10079 HEAT TRANSFER AND FRAGMENTATION DURING MOLTEN-METAL/WATER INTERACTIONS. Witte, L. C.; Vyas, T. J.; Gelabert, A. A. (Univ. of Houston, TX). J. Heat Transfer; 95: No. 4, 521-527(Nov 1973).

Molten metals, (mercury, lead, zinc, bismuth, tin, and aluminum) were quenched in water and liquid nitrogen. High-speed photographs provide insight into the fragmentation phenomenon. The key to the vapor explosion is the very rapid transfer of heat which requires substantial surface area: fragmentation provides this necessary surface area. Prior fragmentation theories are examined in light of these experiments and are found to be inadequate. This study indicates strongly that fragmentation occurs when a sample is molten and fragmentation is a response to an external stimulus. Alternate causes of fragmentation are proposed and are predicated upon the initial collapse of a vapor film around the molten metal. The data also show that energy required to form new surface area and to displace water during the fragmentation phenomenon is not significant when compared to the energy available in a molten sample. (auth)

10080 METHODS FOR EVALUATING THE PERFORMANCES OF COMPACT HEAT TRANSFER SURFACES. Cox, B. (Union Carbide Nuclear Corp., Oak Ridge, TN); Jallouk, P. A. J. Heat Transfer; 95: No. 4, 464-469(Nov 1973).

Methods are presented for evaluating the performances of compact surfaces based on their simultaneous heat transfer rats and pumping power expenditures. Calculations of approximate total costs and volume requirements for a heat exchanger are simplified with the aid of performance curves based on a unit of heat transfer surface area and a unit of exchanger volume. In certain cases, the minimum cost surface can be determined from a single plot and requires no specific cost information. Basic design data are presented for three plate-fin surfaces, each one having a different degree of heat transfer promotion. The attractiveness of each type of surface is shown to depend on the particular design specifications. (auth)

10081 MEASUREMENT OF TURBULENT VELOCITY, INTENSITY, AND SCALE IN ROD BUNDLE FLOW CHANNELS. Rowe, D. S. Corvallis, OR; Oregon State Univ. (1973). 230p. University Microfilms Order No. 73-25, 374.

Thesis (Ph. D.).

An experimental study was performed to investigate the effect of flow channel geometry on fully developed turbulent flow in "clean" rod bundle flow channels. This information was sought to obtain a better understanding of crossflow mixing between rod bundle subchannels. The experiments were performed in water with a Reynolds number range from 50,000 to 200,000. The experimental flow models considered pitch-to-diameter ratios of 1.25 to 1.125. Axial components of velocity, turbulence intensity and Eulerian autocorrelation function were the primary measurements. The autocorrelation function provided an indication of the dominant frequency of turbulence and an estimate of the longitudinal macroscale by using Taylor's hypothesis. A limited amount of lateral component turbulence intensity data was also obtained. The experimental results show that rod gap spacing (pitch-to-diameter ratio) is the most significant geometric parameter affecting the flow structure. Decreasing the rod gap spacing increased the turbulence intensity, longitudinal macroscale, and the dominant frequency of turbulence. These turbulence parameters were found to be rather insensitive to Reynolds number. The turbulence parameters within a rod gap were found to be insensitive to the shape of adjacent subchannels and only slightly affected by the amount of lateral freedom allowed by the various size flow models. The results indicate that macroscopic flow processes exist adjacent to the rod gap. This includes secondary flows and increased scale and frequency of flow pulsations when the rod gap spacing is reduced. When interpreted in terms of crossflow mixing, the results are consistent with present crossflow mixing correlations. (Diss. Abstr. Int., B)

10082 INVESTIGATION OF CRITICAL HEAT FLUX WITH DECREASE IN FLOW THROUGH A HEATED TUBE. Smirnov, O. K.; Pashkov, L. T.; Zaitsev, V. N. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 19: No. 9, 122-126(Sep 1973).

Translated from Teploenergetika; 19: No. 9, 83-85(1972).

An experimental investigation of the influence of the unsteady state caused by a decrease in mass flow of the medium on the conditions of the origination of critical heat flux is described. Values of boundary parameters of critical heat flux were obtained with boiling under steady conditions and under dynamic conditions. The investigation showed that critical heat flux takes place at a mass velocity under dynamic conditions different from the mass velocity for steady conditions for the same enthalpies of the medium. Dynamic experiments with a single decrease in mass flow without maintaining constant pressure showed that in this case low-frequency oscillations of the flow can occur under certain conditions in the experimental channel. The oscillations were accompanied by sharp oscillations of water temperature, which indicate the occurrence and disappearance of critical heat flux. Under such conditions the highest elevation of wall temperature was first observed in the intermediate cross sections of the channel. (LCL)

10083 DYNAMICS OF TWO-PHASE LAYER IN THE TRANSITION ZONE WITH BUBBLING. Tselishchev, P. A. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 9, 44-48(Sep 1973).

Translated from Teploenergetika; 19: No. 9, 30-33(1972).

Equations are developed for expressing the distribution of steam content in the bubbling layer on a heating surface in a steam generator. The calculated results are compared with experimental data. (LCL)

10084 HEAT TRANSFER PROBLEMS WITH NUCLEATE BOILING OF LIQUIDS. Labuntsov, D. A. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 9, 21-28(Sep 1973).

Translated from Teploenergetika; 19: No. 9, 14-19(1972).

Experimental data on and methods for calculating heat transfer coefficients with nucleate boiling of liquids on metallic heating surfaces are discussed with emphasis on the problems created by the effects of the surface conditions of the heating surface. It is concluded that, at the present time, a sufficiently reliable method is available for calculating the mean heat transfer level when boiling normal (nonmetallic) liquids in the region of moderate pressures. However, allowing for the effects of surface conditions remains unsolved and must be further investigated in order to improve the accuracy of design calculations for heat exchangers for thermal and nuclear power plants. (LCL)

10085 SOME CURRENT PROBLEMS IN CONVECTIVE HEAT TRANSFER. Petukhov, B. S. (Moscow Power Inst.). Therm. Eng. (USSR) (Engl. Transl.); 19: No. 9, 1-8(Sep 1973).

Translated from Teploenergetika; 19: No. 9, 2-6(1972).

Some current problems of convective heat transfer which are of importance to thermal power stations, including nuclear power plants, are examined, their present status is characterized, and prospects for solving these problems in the future are discussed. Among the problems discussed is the need for more information on fluid motion and heat transfer in complex heat transfer systems, such as reactors and heat exchangers with complicated channel shapes, in order to intensify the heat transfer processes; gas flows at high temperature and plasma flows at low temperature; the protection of structures against gas flow at high temperature; heat transfer processes in MHD flows; heat transfer with laminar and turbulent flow; and the mathematical modeling of heat transfer conditions. (LCL)

Materials Testing

Refer also to abstracts 10008, 10175, 10296, 10640, 10641, 10668, 12075, 12076, and 12478.

10086 (CEA-CONF-2188) ACOUSTIC EMISSION. Chretien, N.; Miannay, D. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Bruyeres-Le-Chatel (France). Centre d'Etudes). Dec 1972. 47p. (In French). (CONF-730218-2). Dep. NTIS (U.S. Sales Only) $4.50.

From meeting on the propagation of vibrations; Grenoble, France (1 Feb 1973).

Acoustic emission is the creation and spontaneous propagation of stress waves in a solid when it is deformed, fissured, or structurally transformed. The instrumentation in the detection and analysis chain is described, and the treatment of the data is discussed. The application of the method to plastic deformation, rupture, and phase transformations are considered. The technological applications to the detection of fissuration caused by welding, nondestructive control, and surveillance of strongly stressed structures are discussed. (JSR)

10087 (CEA-CONF-2416) GAMMA SCANNING AT THE LECI (CEN SACLAY) AND AT THE LAMA (CEN GRENOBLE). Chevalier, M.; Hulot, J. P.; Lachambre, A.; Mansard, B.; Monnier, J.; Roer, N.; Roussel, E.; Viaux, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Piles). [nd]. 37p. (In French). (CONF-730667-2). Dep. NTIS (U. S. Sales Only) $4.00.

From meeting of the committee on hot laboratories of Euratom; Goesthacht, F. R. Germany (14 Jun 1973).

The γ scanning installations of the hot laboratories of Saclay and Grenoble have received constant improvements during the years both with respect to the acquisition of data and data exploitation. The present facilities for each of these laboratories are described. The principal characteristics of the installations are described. The methods for the carrying out of experiments and for the use of the data are considered. The type of data obtained at the level of defects in the fuel elements and the particular applications are reported. (tr-auth)

10088 (CEA-CONF-2428) AUTOMATIC PROCESSING OF INFORMATION ON THE PRODUCTION OF A NONDESTRUCTIVE CONTROL CHAIN FOR TUBES. Samoel, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Developpement des Elements Combustibles). 7 Mar 1973. 10p. (In French). (CONF-730606-7). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh international conference and exhibition on nondestructive testing; Warsaw, Poland (4 Jun 1973).

During the control of tubes designed for reactor fuel jackets it was necessary to have at one information center all the data received at the apparatus output, data which concerns both the possible defects of the tube and its metrological characteristics. Each tube is numbered so that the number can be read by photoelectric cells, and the number is reported with each piece of data. The chain also has a series of converters which, by testing and integration, transform the analog curves into numerical values (selection at several levels, mean and extreme of the metrological measurements). There are data centralizers which memorize, collect, and process the data of each individual tube for input into a computer. (tr-auth)

10089 (CEA-CONF-2447) CONTROL OF WELDED JOINTS ON A TUBULAR PLATE BY ULTRASONICS AND GAMMAGRAPHY. Cherpentier, C.; Destribats, M. T.; Papezyk, F.; Dobrowolski, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Jan 1973. 6p. (In French). (CONF-730606-4). Dep. NTIS (U.S. Sales Only) $3.00.

From 7th international conference and exhibition on nondestructive testing; Warsaw, Poland (4 Jun 1973).

Two complementary techniques of internal control applicable to welds in tubular exchanger plates and to ferritic or austenitic steels were developed. A first series of tests were carried out on tubular welded joints with a diameter of 10 to 21 mm and a thickness of 2.5 to 5 mm (TIG procedure with and without support metal). Only an interior control is possible. This led to the development of a gammagraphy control with small dimensional ^{170}Tm sources and films slightly sensitive to light. In a parallel manner, an ultrasonic control associated with a Type C recorder permits a qualitative control of the weld. The ultrasonic control of circular pipes on cylindrical bodies of 40 mm thickness of austenitic steel welded by the electron beam method was applied to pieces with an internal diameter of 15 to 54 mm. A special apparatus preserves a fine focusing of the ultrasonics in spite of the concavity of the internal surface of the pipe. A Type C recorder makes it possible to localize the defects and to evaluate their seriousness. The two techniques are applicable jointly in semi-industrial use. (tr-auth)

10090 (GA-8966) NEUTRON RADIOGRAPHY OF IRRADIATED THERMIONIC CONVERTERS. Schwarzer, D. E. (Gulf General Atomic Co., San Diego, Calif. (USA)). 5 Nov 1968. Contract AT(04-3)-167. 38p. Dep. NTIS $4.00.

Declassified 5 Jun 1973.

Neutron radiography was developed for the nondestructive examination of thermionic converters irradiated in the Gulf General Atomic TRIGA Mark III reactor. Indium, dysprosium, and iridium foils were used as the neutron image detector and yielded good quality images of the converter and its instrumentation. An autoradiograph of the irradiated foil was taken to reproduce the radiographic image on photographic film. Gamma graphs of the converters prior to irradiation and neutron radiographs after irradiation were examined and compared. (auth)

10091 (N-73-28517) NONDESTRUCTIVE TESTING: A SURVEY. (Southwest Research Inst., San Antonio, Tex. (USA)). 1973. 283p. (NASA-SP-5113). GPO $3.00.

A separate abstract was prepared for one section of the report on radiography. The remaining sections were not in the subject scope of NSA. (TFD)

For an abstract of an individual section see: 10092.

10092 (N-73-28517, pp 63-99) RADIOGRAPHY. Gardner, C. G. 1973. (N-73-28521).

In nondestructive testing: a survey.

Radiography is discussed as a method for nondestructive evaluation of internal flaws of solids. Gamma ray and X-ray equipment are described along with radiographic film, radiograph interpretation, and neutron radiography. (STAR)

10093 STANDARD METHOD FOR CONTROLLING QUALITY OF RADIOGRAPHIC TESTING. 1973 Annual Book of ASTM Standards. Part 31. Philadelphia; American Society for Testing and Materials (1973). 10p. (ASTM-E-142-72).

This method covers the radiographic testing of materials for internal discontinuities, and also the use of film and other recording media. Requirements expressed in this method are intended to control the reliability or quality of the radiographic images, and are not intended for controlling the acceptability or quality of materials or products. The number of areas or parts to be radiographed and the acceptance standard to be applied shall be specified in the contract, purchase order, product specification, or drawings. The quality level required for radiography shall be at least 2 percent (2-2T), unless a higher or lower quality is agreed upon by the purchaser and the supplier. (TFD)

10094 STANDARD RECOMMENDED PRACTICE FOR SURVEILLANCE TESTS FOR NUCLEAR REACTOR VESSELS.

1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-E-185-73).

This recommended practice covers procedures for irradiating and testing mechanical test specimens for the purpose of monitoring and evaluating, at periodic intervals, the radiation-induced changes occurring in the mechanical properties of the reactor vessel steels of light water-cooled nuclear power reactors. (auth)

10095 STANDARD RECOMMENDED PRACTICE FOR EXAMINATION OF FUEL ELEMENT CLADDING INCLUDING THE DETERMINATION OF THE MECHANICAL PROPERTIES. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 15p. (ASTM-E-453-72).

This recommended practice covers the procedures for post-irradiation examination of nuclear fuel elements, selection of material and tests for radiation studies, determination of radiation conditions, conduction of tests for mechanical properties of cladding, and the reporting of data. The purpose of this recommended practice is to provide detailed guidelines for the post-irradiation examination of fuel cladding and to achieve better correlation and interpretation of the data in the field of radiation effects. This recommended practice may be applied to metallic cladding from all types of fuel elements and the tests for determining mechanical properties of the fuel element cladding described in this practice could be used in planning radiation effect tests for evaluation of materials for cladding and other components in nuclear reactors. (auth)

10096 PERIODIC INSPECTION OF LIGHT WATER REACTOR PRESSURE VESSELS. Watkins, B. (UKAEA Reactor Group, Risley, Eng.). Brit. J. Non-Destruct. Test.; 15: No. 6, 165-175 (Nov 1973).

The NDT techniques necessary for periodic inspection of the pressure vessels of nuclear reactors are described. Special emphasis is made of the need for remotely controlled systems which can be used in hostile environments where there would be severe radiation hazard. Special ultrasonic techniques have been developed using both single and multi-probe systems, B-scan presentation and a permanent record. The performance of these systems on different geometries of defect and specimen has been assessed. (auth)

Nuclear Explosions

Refer also to abstracts 10132 and 11691.

10097 (FOA-4-4558-A-1) TWO USSR EXPLOSIONS IN EASTERN KAZAKH, DECEMBER 10, 1972. Event Report No. 10. (Foersvarets Forskningsanstalt, Stockholm (Sweden). Hagfors Observatorium). Oct 1973. 14p. Dep. NTIS (U.S. Sales Only) $3.00.

The recorded short- and long-period signals obtained at the Hagfors Observatory from two USSR explosions in Eastern Kazakh on December 10, 1972 are presented. (auth)

10098 (JPRS-60185) FORMATION OF RADIOACTIVE PARTICLES IN NUCLEAR EXPLOSIONS. Translated from Tr., Inst. Eksp. Meteorol.; No. 21, 91-111(1971). 27p. Dep. NTIS.

A separate abstract was prepared for each of the four papers in the report. (TFD)

For abstracts of individual papers see: 10099–10102.

10099 (JPRS-60185, pp 1-8) FORMATION OF RADIOACTIVE PARTICLES IN TROPOSPHERIC NUCLEAR EXPLOSIONS. Izrael, Yu. A. 1971.

Some possible mechanisms of the formation of radioactive particles in the fire ball and cloud of nuclear explosions in the troposphere are presented. (TFD)

10100 (JPRS-60185, pp 9-14) EFFECTS OF FRACTIONATION IN ATMOSPHERIC NUCLEAR EXPLOSIONS. Izrael, Yu. A. 1971.

An improved method for calculating the fractionation of radioactive particulates in atmospheric nuclear explosions is presented. (TFD)

10101 (JPRS-60185, pp 15-17) FORMATION OF SECONDARY AEROSOLS IN THE ATMOSPHERE DURING A VENTILATED UNDERGROUND NUCLEAR EXPLOSION. Petrov, V. N.; Ter-Saakov, A. A. 1971.

A method of calculating the formation of decay products from gaseous radioisotopes which have escaped from underground nuclear explosions is presented. (TFD)

10102 (JPRS-60185, pp 18-25) DISTRIBUTION OF HIGHLY ACTIVE PARTICLES ACCORDING TO DIMENSIONS IN THE TROPOSPHERE IN SEPTEMBER–DECEMBER 1967. Gaziev, Ya. I.; Malakhov, S. G.; Nazarov, L. E. 1971.

Observations by various researchers show that during the periods of atmospheric nuclear tests and during the first months following such tests a considerable part of the radioactive products of the tests is connected with aerosol particles, which have individual activities of the order of 10^{-12} to 10^{-11} curies and above. At the present time theoretical and experimental data can be found in the literature to the effect that the behavior of these highly active particles in the atmosphere and their radioisotopic composition may depend to a considerable extent on particle size. Therefore, in order to understand the space–time pattern of contamination of the atmosphere and the earth's surface with nuclear blast products during the first 6 months following the tests it is necessary to know the distribution of highly active particles in terms of dimensions. Results of a study of highly active particles in the troposphere at 45 to 60° north latitude in European USSR are given. (TFD)

10103 (LA-5425-MS) IN SITU PERMEABILITY MEASUREMENTS FOR THE EVENT IN U1-C. Keller, C.; Engstrom, D.; West, F. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

Test apparatus was designed for the measurement of the in situ permeability in the vicinity of the 1100-ft U1-C shaft at NTS. A very reasonable approximation to a one-dimensional flow geometry was obtained. Measurement of gas injection flow rates and pressures allowed the determination of the effective permeability of the medium around the U1-C shaft to be from 1 to 10 darcys with the major exceptions at depths of less than 200 ft where the permeability was greater than 40 darcys. However, permeability results were seen to vary with source pressure and, therefore, must be used with discretion. (auth)

10104 (LA-5449-MS) SIMULATION OF TURBULENCE IN FIREBALLS. Ruppel, H. M.; Gentry, R. A.; Daly, B. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

The ALE technique is applied to the calculation of a small yield, low altitude nuclear explosion. When artificial diffusion effects caused by numerical errors are minimized, the fireball rises too rapidly, reaching an altitude in excess of that which is observed. This suggests that turbulent diffusion and entrainment may be important. Hence, a turbulence model has been added to later calculations of the fireball dynamics. Some of the more important features of the calculational technique and the turbulence model are discussed. Preliminary results for a set of turbulence parameters and a particular low altitude fireball are presented. (auth)

10105 (ORNL-4903, pp 166-171) EFFECTS ON CIVILIAN SYSTEMS FROM HIGH-ALTITUDE DETONATIONS. Baird, J. K.; Barnes, P. R.; Manweiler, R. W.; Marable, J. H.; Nelson, D. B. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Research on the effects of an EMP (electromagnetic pulse) from a high-altitude nuclear detonation on electrical systems is reviewed. Topics include surges induced in transmission lines; effects of EMP on the supervisory control equipment of a power station; the stability of the electric power system in a nuclear electromagnetic environment; effects of electromagnetic pulse on radio communications; and the voltage induced in infinite, lossless, two-wire transmission line by parallel finite current sources. (WHK)

10106 (PEL-224) SEISMIC DAMAGE AND THE ECONOMY OF THE USE OF NUCLEAR EXPLOSIONS. Retief, J. V. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). Jul 1972. 39p. (In Afrikaana). INIS.

One of the most important restrictions on the constructive use of nuclear explosions is the damage caused to buildings and structures situated at great distances around the explosion as a result of the seismic waves generated. The effect of seismic damage on the economy of the use of nuclear explosions in general is investigated. Results of the investigation are applied to conditions in South Africa. Various phases in the mechanism of seismic damage are discussed, namely generation by the explosion, propagation by the earth's crust, amplification by the geological structure of foundations and damage to structures. Predictions are made of reaction spectra as a function of explosive force, explosive depth, placing material and distance to the observation point. The nature, extent and cost of seismic damage as a function of distance and population of urban centers and density of rural population are estimated. Information on population distribution in South Africa

are analyzed, and areas where explosions can be detonated without serious seismic damage are indicated with the aid of predictions of the cost of seismic damage. Charges with an explosive force of 10 to 100 kt can be detonated over large areas in South Africa, but bigger charges (1000 kt) are restricted to the sparsely populated areas of the Northern and Northwestern Cape. (INIS)

10107 (UCRL-51391) PONDER: A FORTRAN CODE THAT GRAPHICALLY REPRESENTS NUCLEAR BLACKOUT EFFECTS. Maples, M. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Aug 1973. Contract W-7405-eng-48. 130p. Dep. NTIS $5.45.

The PONDER Code (Pictures of Nuclear Device Effects from RANC), which has been used at Lawrence Livermore Laboratory for performing radar blackout analyses is described. PONDER is an executive routine in which the well-known radar blackout code RANC (Radar Absorption Noise and Clutter) is a major subroutine. "Radar blackout" refers to ionization levels that are produced by a nuclear burst and that cause sufficient absorption or refraction of a signal to make the radar system under study ineffective. In general, PONDER outputs two types of data: computer-generated pictures of blackout, and calculations of blackout area in square kilometers. These computer-generated pictures consist of either a "projection" of blackout onto a hemispherical shell or a "projection" onto a constant-altitude surface or a "projection" onto a plane. (TFD)

10108 (UCRL-51426) PALLOT: A FORTRAN CODE THAT PRODUCES GRAPHICAL REPRESENTATIONS OF NUCLEAR BLACKOUT EFFECTS ALONG A REENTRY TRAJECTORY. Maples, M. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.) 17 Aug 1973. Contract W-7405-eng-48. 123p. Dep. NTIS $5.45.

The PALLOT code was developed to simplify the assimilation of data relating to effects of nuclear blackout on particular reentry trajectories. This code operates in three modes: azimuth, elevation, and inline. In the azimuth and elevation modes, the PALLOT picture represents a family of trajectories that only vary, respectively, in approach azimuth and impact elevation angle. The incline mode depicts a set of reentry vehicles approaching on the same trajectory through a nuclear environment. The code, written in Fortran IV, was developed on the CDC 7600 computer; it will run on the CDC 6600 without modification although the run times may be excessively long. (auth)

10109 (UCRL-75044) IN-PLACE LEACHING OF PRIMARY SULFIDE ORES: LABORATORY LEACHING DATA AND KINETICS MODEL. Braun, R. L.; Lewis, A. E.; Wadsworth, M. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1973. 17p. (CONF-740202-1). Dep. NTIS $3.00.

From AIME solution mining symposium; Dallas, Texas, USA (Feb 1974).

Experimental results obtained in laboratory leaching studies of primary copper sulfide ore in sulfuric acid systems pressurized with oxygen are interpreted by a computerized geometric model involving the movement of a reaction zone through the ore fragments. Physical properties of the ore, including size, shape, and mineral content, are considered. The leaching mechanism involves mixed kinetics and includes a surface reaction within a moving reaction zone plus pore diffusion of dissolved oxygen through the reacted portion of the ore fragment to the reaction zone. The results are applicable to conditions that would exist in nuclear solution mining or similar processes in which the ore is converted into rubble and then inundated by a leach solution adequately supplied with oxidants. Experimental results at 90°C are correlated with the model, which includes temperature-dependent parameters. (auth)

10110 PROBLEMS RELATED TO PcP AND THE CORE-MANTLE BOUNDARY ILLUSTRATED BY TWO NUCLEAR EVENTS. Buchbinder, G. G. R.; Poupinet, G. (Institut de Physique du Glove, Paris). Bull. Seismol. Soc. Amer.; 63: No. 6, 2047-2070(Dec 1973).

Two large nuclear explosions produced a considerable number of PcP phases. Analysis of the P and PcP travel times shows a scatter of ±2 sec. It is pointed out that PcP and P times must be considered together to eliminate gross upper mantle effects on the travel times. On a worldwide basis, the PcP peak-to-peak amplitudes exhibit a scatter of up to one order of magnitude, and, thus, the reflection coefficient of the core-mantle boundary (cmb) may not be determined with any significance from them. Comparing the wave form of PcP and the wave form of P waves convolved with thin-layered models of the cmb suggests that the cmb may be approximated by a thin high-impedance liquid layer of several kilometers in thickness embedded between the mantle and the core. Such a model can explain observed dilatational arrivals and a small decrease in amplitude near $\Delta \approx 30°$. The data do not permit exact determination of the model parameters because of uncertainty in the data and insensitivity of the method and because the cmb also may be laterally inhomogeneous. The frequency-dependence of the reflection and transmission coefficients of a layered cmb would have serious effects on the determination of inner core parameters. (auth)

10111 LEGAL PROBLEMS OF PEACEFUL NUCLEAR EXPLOSIONS. von Welch, S. (Bundesministerium fuer Forschung und Technologie, Bonn). (1973). vp. (In German).

From first international meeting on nuclear law: Nuclear Inter Jura 73; Karlsruhe, Ger. (11Sep 1973).

The problems resulting from the Non-Proliferation Treaty for the restriction of nuclear weapons without excessive impairment to the peaceful application of nuclear energy are discussed. Two possible solutions are indicated. Three problems are presented concerning the relations of non-nuclear weapons states with nuclear weapons' states, i.e., extent of engagement and carrying out of the explosion service (international procedures, IAEA procedures) and the conflict situation resulting from the Nuclear Test Ban Treaty of 1963 including the planned changes of the treaty. (GE)

Protective Structures and Equipment

10112 (AERE-R-5514) SOLVENT FIRES AND EXPLOSIONS IN GLOVE BOXES: INVESTIGATION TO DETERMINE MINIMUM HAZARDOUS QUANTITY. May, F. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1973. 55p. Dep. NTIS (U. S. Sales Only) $4.75. UK £1.00.

The report is in two parts: Part 1 reports on fire and explosion tests in glove boxes with a static atmosphere and on the attempts to determine a safe minimum quantity of solvent that can be introduced into a glove box. Part 2 describes similar tests in glove boxes with a purged atmosphere and examines the effect of solvent vapor dispersal on fire and explosion risks. (auth)

Safety Engineering

10113 (AES-11) FIRE STUDIES OF PLASTIC ISOLATED ELECTRIC CABLES, SEALING CABLE LEAD-IN, INTERLOCKING CELLS, AND INTERLOCKING FLOORS. Danielsson, G.; Elgh, L. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 114p. (In Swedish). Dep. NTIS (U.S. Sales Only) $7.75.

The types of cable sealings used in modern power plants as well as some new types of cables have been tested against fire. Experiments have been performed both on small and large scales. Small scale experiments were made to test horizontally and vertically installed cable lead-ins and different types of cable lead-ins. The large scale experiments were made to study sealing cable lead-ins in walls and strength of interlocking cells and floors with cable passages connected to cable shafts in case of fire. Finally heat, smoke and fire propagation through cable lead-ins have been studied. (SW)

10114 IONISING RADIATIONS: A PROBLEM FOR THE FIRE SERVICE. I. Greenwood, T. Fire Eng. J.; 33: No. 90, 32-34 (Jun 1973).

The problems that arise when dealing with fires where there may also be radioactivity are discussed. Reference is made to a Technical Bulletin on Fire Fighting Hazards of Radioactive Materials published by the Home Office in 1958. The National Arrangements for Incidents involving Radioactivity (N.A.I.R.) were introduced in 1964 but the scheme is stated to be limited in scope. Examples are given of some of the incidents that have occurred in the USA and in this country where the fire services have been involved. The importance of liaison between the fire services and technical experts is stressed. (UK)

10115 IONISING RADIATIONS: A PROBLEM FOR THE FIRE SERVICE. II. Greenwood, T. Fire Eng. J.; 33: No. 91, 50-55 (Sep 1973).

The contingency plans and special equipment used by the fire services in dealing with fires where there may also be radioactivity are described. The use of radioisotopes for industrial and medical purposes is outlined, and a list of radioisotopes is arranged in order of toxicity. Methods of assessing the radiation hazards are discussed. Fire prevention measures are considered in relation to buildings or equipment containing radioactive materials. Regulations concerning the transport of radioactive materials are referred to. (UK)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstracts 9907 and 12168.

10116 URANIUM IN ITS NATURAL COMPOUNDS. Quellmalz, W. (Staatliches Museium fuer Mineralogie und Geologie, Dresden). Kernenergie; 16: No. 3, 73-77(Mar 1973). (In German).

The first minerals of uranium were described (specific appearance and properties) a long time before the element uranium was discovered. Their number, however, remained in a small limit after obtaining uranium oxide (Klaproth 1789) and the element uranium (Peligot 1841). Only when the 20th century began the number of the known minerals of uranium, or of minerals with a fixed content of uranium, increased. According to the form of occurrence distinction can be made between primary and secondary minerals of uranium. They also differ with regard to their chemical valence (tetra- or hexavalent). In the description of the most important substitutes of both groups the essential attributes, the kind of occurrence, and the economic importance are mentioned. (auth)

10117 RELATION OF URANIUM MINERALIZATION TO CERTAIN VARIETIES OF URANO-FERROUS SODIUM METASOMATITIES. Zinchenko, V. A. (Inst. of Geochemistry and Physics of Minerals, Kiev). Geol. Zh. (Russ. Ed.); No. 6, 84-89(Nov 1972). (In Russian).

Sodium metasomites and related uranium ores are limited to regional structures of submeriodinal areas found in deep fractures. These fractures occur in migmatites, granites, biotite and amphibole-biotite gneisses of Pre-Cambrian age and are consistent with the extent and decrease in the band structure of gneisses and migmatites. Sodium metasomites are formed in all petrographic varieties and depending on the completeness of the exchange, may be subdivided into albitites, syenite-like desiliconized rocks, and slightly alkaline rocks. Uranium minerals are localized almost exclusively in the albitites and are present as uranotitanates, uraninite, uranite, coffinite, and other minerals in insignificant amounts. The albitites are present as apogranites, apogneisses, and apomigmatites. Selective limitation of uranium mineralization to these varieties is explained by their peculiarities-in some cases physico-mechanical properties that favorably affect the formation of uranium minerals and in other cases to their mineralogy. Apogranite varieties are more predisposed to development of brittle deformations, which is reflected in the development of small fractures, cataclases, and milonitization, contributing to localization of uranium ores. Apogneiss and apomigmatite varieties are characterized by a high content of dark-colored minerals, which affect the precipitation of uranium from solution. (trans-auth)

10118 SEQUENCE OF MINERAL FORMATION IN SODIUM METASOMATITES AND SOME ASPECTS OF URANIUM MINERALIZATION GENESIS. Rakovich, F. I. (Inst. of Geochemistry and Physics of Minerals, Kiev). Geol. Zh. (Russ. Ed.); No. 6, 78-84(Nov 1972). (In Russian).

Uranium mineralization, confined to albitites, is chiefly in the form of uranotitanates. The formation of uranium-bearing metasomatites goes through two stages: albite-aegirite-ribekite-chlorite-uranotitanate and uraninite-epidot-quartz-chlorite-carbonate. The albitites and basic masses of uranium minerals are formed in the first, albite-uranotitanate, stage. The uranotitanates forms in the direct interaction of uranium solutions with titanium minerals (sphene, rutile ilmenite, dark-colored minerals) and partially upon precipitation of titanium and uranium from solution. In paragenesis with uranium minerals egirin is observed, but most often in the development of uranotitanate according to the dark color, egerin becomes unstable and is completely or partially replaced by a fibrous amphibole type of crossite, and sometimes a hydrobiotite or chlorite is developed. Almost simultaneously with uranotitanite, a hematite dispersion is separated out. The largest amount of uranotitanite is formed in the process of metasomatosis, and only in spots is there a deposit in the open. This is indicated by a predominance of metasomatic texture-dispersed, nested, filament-dispersed and uranotitanates developed through sphene leucoxene, and dark-colored minerals. In the second stage, after renewal of tectonic shoves, leading to formation of small fractures, milonitization, cataclase, brecciation, fibrous precipitates of minerals of recent generation are formed. From uranium minerals are formed uranium oxides and silicates. In some places where carbonates are widely developed, uranotitanates and other uranium minerals are destroyed as they are replaced by carbonates. In some places, regenerated uranotitanates, uranites, and uraninites are found. (trans-auth)

10119 WALLROCK ALTERATION AS A GUIDE TO EXPLORATION FOR URANIUM MINERALS IN SODIUM METASOMATITES. Rakovich, F. I. Geol. Zh. (Russ. Ed.); 32: No. 3, 110-115(Mar 1972). (In Russian).

In regions where sodium metasomites have developed, uranium mineralization is limited to albitites containing dark-colored minerals. These are a favorable medium for uranium precipitation. Uranium precipitation is affected by the presence of secondary minerals which contain ferrous iron. Uranium mineral deposition is favored by coarse and fine grained albitites containing the alkali minerals amphibole, egirin, chlorite, sometimes biotite. In the reaction of dark-colored minerals with ore solutions containing uranium carbonate ion complexes, the uranium is apparently reduced by divalent iron released in the precipitation of dark colored minerals-leucoxene, sphene, and others containing Ca, Mn, and Fe, which explains the origin of hematization haloes around ore zones, the development of carbonates, circum-ore crossite, hydrobiotite, and chlorite. Geochemical circum-ore changes in sodium metasomatites appear in the development of a number of elements accompanying the uranium. In uranium-bearing albitites particles are found with high lead, zirconium, yttrium, titanium, vanadium, thorium, phosphorus, and beryllium contents. It has been established that circum-ore changes in connection with lithological and structural criteria may be important indications of the presence of uranium-bearing albitites. (tr-auth)

Radioactive Effluents

Refer also to abstracts 10397, 12015-12017, and 12028.

Radioactivity Monitoring and Transport

Refer also to abstracts 12014, 12015, 12034, and 12037.

10120 (ARH-1972) RADIOACTIVE EFFLUENT REDUCTION FROM 200 AREA FACILITIES. Hanson, G. L. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 29 Jan 1971. 28p. Dep. NTIS $3.50.

Results are reported from a comprehensive study of radioactive wastes discharged to the environment in the 200 Area (chemical processing area) of the Hanford Reservation. Guides for the emission of gaseous waste were being met for the discharge of ^{131}I, ^{90}Sr, mixed fission products, and ^{239}Pu. Treatment systems for reduction of NO_2 from several stacks were proposed, and a prototype system for the removal of UO_3 from stack gases was developed and tested. Significant reductions of radioactivity in soil were achieved during a three to four year period by changes in operating procedures and minor expenditure of funds for process and equipment improvements. Emphasis was placed on the treatment of liquid wastes for the removal of ^{137}Cs, ^{90}Sr, and ^{239}Pu from those streams prior to discharge to the environs. Improved methods for the monitoring and cycling of radioactive wastes, cooling waters, and steam condensates from process vessels were also developed. (CH)

10121 (BNWL-CC-637-12) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR DECEMBER 1966. (Annual Summary). Essig, T. H.; Hall, R. B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 20 Mar 1967. 73p. Dep. NTIS $5.75.

Data are summarized on levels of radioactivity in environmental samples collected at Hanford during 1966, including detailed data on samples collected during December. Data are included on the radioactivity in fallout from Chinese and Russian nuclear weapons test, samples of drinking water and Columbia River water, the ^{56}Mn content of Columbia River water sampled at various locations, the ^{131}I content of gaseous wastes and surface waters, and the radioactivity of soil samples from the chemical separations liquid waste treatment and disposal area. The radiation dose to personnel during the year from all environmental sources was estimated to be less than 0.3 percent of the applicable limits. (CH)

10122 (BNWL-CC-913) ENVIRONMENTAL STATUS OF THE HANFORD PROJECT. 1965 Annual Summary. Essig, T. H.; Hall,

R. B. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 8 Nov 1966. Contract AT(45-1)-1830. 47p. Dep. NTIS $4.50.

Data are summarized on the radioactivity in environmental samples collected within the Handford Reservation during 1965. Data are included on the gross α and β activity of samples of drinking water, Columbia River water, underground and surface water; the content of ^{32}P, ^{137}Cs; and ^{65}Zn in the tissues of waterfowl; the total β activity and ^{131}I content of air filter samples from various locations; and aerial surveys of surface γ contamination. Results of personnel monitoring are also reported. (CH)

10123 (BNWL-CC-1197-6) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR NOVEMBER–DECEMBER 1967. (Annual Summary). Wooldridge, C. B. (ed.). (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Apr 1968. 84p. Dep. NTIS $6.25.

Data are summarized on levels of radioactivity in environmental samples collected at Hanford during 1967. Detailed data are included on samples collected during November and December including samples of Columbia River water, surface waters, drinking water, game birds, and the atmosphere. Fallout radionuclides were identified. Transient increases in total β activity and ^{131}I content of the atmosphere were related to plant operations. Radioactive particles released from stacks also resulted in localized ground contamination. (CH)

10124 (BNWL-SA-4658) NOVEL PARTICLE-SIZING TECHNIQUE FOR HEALTH PHYSICS APPLICATION. Waite, D. A.; Nees, W. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. 9p. (CONF-731117-2; SM-180/43). Dep. NTIS $3.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

A new concept in the sizing of radioactive or nonradioactive airborne particulate matter has been assembled into a mobile field unit and is being applied to present environmental and health physics particle size information needs. The glow-discharge perturbation method economically generates particle size data which can be directly accumulated and spectrometrically analyzed by a multichannel analyzer. The basics of the glow-discharge technique are touched upon and compared to other instrumentation presently available in this province of the environmental sciences. The physical description, operational characteristics and current uses of the apparatus are detailed, along with important design and operational parameters. Particle size distribution data and analysis techniques illustrating the utility of this system are presented. (auth)

10125 (CONF-720692-) PROCEEDINGS OF THE 11TH ANNUAL ENVIRONMENTAL AND WATER RESOURCES ENGINEERING CONFERENCE, NASHVILLE, TENNESSEE, JUNE 1–2, 1972. Benedict, B. A. (ed.). (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Environmental and Water Resources Engineering). [nd]. 205p. DEWRE, Vanderbilt Univ., Nashville, TN $6.00.

From 11th annual environmental and water resources engineering conference; Nashville, Tennessee, USA (1 Jun 1972).

Separate abstracts were prepared for three of the 17 papers included. Other papers discuss various aspects of environmental engineering and water resource management. (CH)

For abstracts of individual papers see: 10144, 10164, and 10168.

10126 (HW-69369) COMPILATION OF BASIC DATA RELATING TO THE COLUMBIA RIVER. Section 8. Dispersion of Reactor Effluent in the Columbia River. Soldat, J. K. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 16 Nov 1962. Contract AT(45-1)-1350. 241p. Dep. NTIS $14.25.

Results are summarized from reactor effluent dispersion studies, and measurements of temperature, velocity, and gross α and β radioactivity of the Columbia River in the vicinity of the Hanford Project from 1946 through early 1961. For convenience, all of the tables related to a particular subsection are grouped together at the end of that subsection. Velocities were usually measured in conjunction with other parameters, such as temperature or radioactivity. (CH)

10127 (HW-72645-RD) CHEMICAL EFFLUENTS TECHNOLOGY WASTE DISPOSAL INVESTIGATIONS, JULY–DECEMBER 1961. Brown, D. J. (ed.). (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). Feb 1962. Contract AT(45-1)-1350. 17p. Dep. NTIS $3.00.

Data are presented on the radioactivity in samples of ground water collected at various locations at the Hanford Reservation during the last half of 1961. A ground water contamination map is included that shows the relation between radioactive waste disposal and radionuclide migration to ground water. Samples of water from special monitoring wells were analyzed for total α, gross β, ^{137}Cs, ^{90}Sr, ^{144}Ce, ^{144}Pr, ^{147}Pm, ^{60}Co, ^{106}Ru, ^{95}Zr, ^{95}Nb, and tritium. (CH)

10128 (INIS-mf-576) DETERMINATION OF THE QUANTITIES OF RADIOACTIVITY WHICH CAN BE DISCHARGED IN THE ATMOSPHERE AND IN THE RIVERS BASED ON THE PRACTICAL KNOWLEDGE OF THE DIFFUSIVE CAPACITY OF THE ENVIRONMENT. Bultynck, H.; Fieuw, G. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 18p. (In Dutch). INIS.

For discharges to the atmosphere, the standard doses for the population living near nuclear installations of S.C.K./C.E.N. are demonstrated as a function of the critical method of exposure. Specific studies were undertaken at S.C.K./C.E.N. for determining factors of dilution and means of deposit in direct relation to meteorological parameters measured routinely. When the diffusive capactiy of the atmosphere and the standard doses for the population of the vicinity are known, which can eventually be corrected, one obtains at the locality of the discharge the source conditions for taking into account the points of simultaneous discharge of the same isotope. For discharges into streams, the philosophy of S.C.K./C.E.N. is applied. (HLW)

10129 (UCLA-12-937) SOME ECOLOGICAL ATTRIBUTES AND PLUTONIUM CONTENTS OF PERENNIAL VEGETATION IN AREA 13. Romney, E. M.; Wallace, A.; Gilbert, R. O.; Bamberg, S. A.; Childress, J. D.; Kinnear, J. E.; Ackerman, T. L. (California Univ., Los Angeles (USA). Lab. of Nuclear Medicine and Radiation Biology). Nov 1973. Contract AT(04-1)-GEN-12. 19p. Dep. NTIS $3.00.

Progress is reported on work conducted at the Nevada Test Site under the auspices of the Nevada Applied Ecology Group, Office of Effects Evaluation, USAEC Nevada Operations Office, Las Vegas, Nevada. Included are data on some ecological attributes of the vegetation within the fenced portion of the Project 57 fallout pattern in Area 13. Also included are some preliminary data on the $^{239-240}Pu$ and ^{241}Am in samples of vegetation collected in conjunction with the soil sampling program. Prominent shrub and grass species in the fallout pattern of Area 13 include Artemisia spinescens, Atriplex canescens, Atriplex confertifolia, Eurotia lanata, Grayia spinosa, Kochia americana, Lycium andersonii, and Oryzopsis hymenoides. Individual or co-dominant species distinguished local association patterns of varied size within the fenced study area. Vegetation cover estimates in sample study plots ranged from 12.8 to 28.3 percent. Shrub densities ranged from 11.2×10^3 to 17.9×10^3 plants per hectare, and the standing shrub biomass ranged from 1592 to 4285 kilograms per hectare (0.7 to 1.9 tons per acre). Preliminary results showed rather uniform distributions of $^{239-240}Pu$ and ^{241}Am among individual samples of the same plant species collected within an intensive study plot. However, there was considerable variation in the contamination levels between different species, presumably from superficial entrapment of resuspended particulate material. Concentrations in Eurotia lanata were three to five times higher than in other species sampled from the same study site. The $^{239-240}Pu$ and ^{241}Am generally tended to decrease in samples of vegetation collected at increasing distances from ground zero, but there were poor correlations between vegetation and soil $^{239-240}Pu$ concentrations in isopleth strata within the fenced grazing area. Results showed inconsistencies in the Pu/Am ratios for vegetation and soil. Lower ratios found in vegetation samples indicate that preferential uptake and concentration of ^{241}Am through plant roots might have occurred in the Project 57 fallout area. (auth)

10130 EFFECT OF VEGETATION SCREENING ON THE DISPERSION AND DEPOSITION OF ATMOSPHERIC POLLUTANTS ON THE GROUND. Belot, Y.; Caput, C. (CEN de Saclay, Gif-sur-Yvette, France). Agriculture (Paris); No. 366, 175-177 (Jun 1973). (In French).

In the framework studies of the transfer of particle or gaseous radioactive pollutants between the atmosphere and the ground, the diffusion conditions in a free atmosphere were studied together with transfer to the ground and to the vegetation coverage (thin curtain of trees or bushes, wooded regions of relatively small area, and large dense forests). Thin screens modify the air currents (breeze-wind), while thick screens result in the filtration of the air masses and the capture of particle or gaseous pollutants on the branches and leaves. (FR)

Atmosphere

Refer also to abstracts 10189, 10212, and 10213.

10131 (NYO-3425-8) PROGRESS REPORT FOR THE PERIOD APRIL 1, 1973 THROUGH NOVEMBER 7, 1973. Reiter, R. (USAEC, Washington, D. C.; Fraunhofer-Gesellschaft zur

Foerderung der Angewandten Forschung e.V., Garmisch-Partenkirchen (F.R. Germany). Physikalisch-Bioklimatische Forschungsstelle). 7 Nov 1973. Contract AT(11-1)-3425. 35p. Dep. NTIS $3.75.

Research on the penetration of stratospheric air into the troposphere continued with daily sampling of the atmosphere at Zugspitze in the Bavarian Alps and with the analysis of samples for fallout heavy metals, ozone, and cosmic-ray-generated ^{7}Be, ^{32}P, and ^{35}S. (DHM)

10132 OBSERVATION OF RADIORUTHENIUM AND RADIOCERIUM ISOTOPIC ACTIVITY RATIOS IN RAIN WATER. Matsunami, T.; Mizohata, A.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 30-34(Mar 1973).

Since the end of 1969 the variation with time of the isotopic activity ratios of ^{103}Ru to ^{106}Ru and ^{141}Ce to ^{144}Ce was examined in rainwater. In the period from November 1971 to August 1972 three main peaks of the two isotopic activity ratios appeared resulting from the twelfth (November 18, 1971), the thirteenth (January 7, 1972), and the fourteenth (March 18, 1972) Chinese nuclear explosions. The method of calculation, which was given by Telegadas and Murayama for estimating the contribution of the ^{90}Sr produced in a new explosion to the total deposition of ^{90}Sr from the observed isotopic activity ratio of ^{89}Sr to ^{90}Sr, was applied to estimate the contributions of the ^{106}Ru and ^{144}Ce produced in a new explosion to the total depositions of these nuclides. (auth)

10133 NATURAL β-ACTIVITY OF THE AIR IN THE ATMOSPHERIC SURFACE LAYER. Israelsson, S.; Knudsen, E.; Ungethum, E. (Uppsala Univ.). Atmos. Environ.; 7: No. 11, 1127-1137(Nov 1973).

Measurements of the natural β-activity variations in the atmospheric surface layer for the period 1960 to 1970 are discussed in connection with meteorological variables. The diurnal variation of the β-activity increases, when approaching the ground surface from above. The phase of the diurnal wave increases with height. This means that the time of maximum becomes later with increasing height. The greatest phase velocities occur during late winter and spring. The variations of the natural β-activity seem to agree with temperature for frequencies below 1 period per hour. The influence of atmospheric stability upon natural β-activity is also studied. (auth)

Soil

Refer also to abstracts 9852 and 10159.

10134 (ARH-1945) B PLANT ION EXCHANGE FEED LINE LEAK. Tanaka, K. H. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 25 Jan 1971. 13p. Dep. NTIS $3.00.

One of the objectives of the Waste Management Program is to separate the long-lived heat emitter ^{137}Cs from the bulk of the high-level liquid wastes. This separation is accomplished by the ion exchange process in the 221-B Building. Interim storage of the cesium is in solution as a nitrate. The feed for the B Plant cesium ion exchange process is pumped from the lag storage tank, 105-C, through a pipeline and several diversion boxes to the 221-B Building. On December 19, 1969, a leak was discovered near the 241-C-152 diversion box in the section of this line, V-122, from the 105-C tank. Although the leak represented a loss of feed for the processing of ^{137}Cs, more important was the consequence of environmental contamination to the soil from the line leak. For this reason, an investigation was made to establish the extent of the radioactivity spread. The results of a well drilling operation undertaken to define the boundary and to estimate the extent of the leak are summarized. (CH)

10135 (ARH-2015(Pt.4)) RADIOACTIVE CONTAMINATION IN UNPLANNED RELEASES TO GROUND WITHIN THE CHEMICAL SEPARATIONS AREA CONTROL ZONE THROUGH 1970. Maxfield, H. L. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 30 Mar 1971. 13p. Dep. NTIS $3.00.

Data are summarized regarding sites containing unconfined radioactive materials resulting from unplanned releases to soil storage in the chemical processing area of the Hanford reservation. Each site is identified with the location, description, and history of the event, as well as the amount and kind of radioactive material present. Included are spills, process transfer line leaks informal burial sites, locations contaminated by airborne radioactive particulates, and spreads of radioactivity by animals. The report covers releases from plant startup in 1944 through calendar year 1970. (auth)

10136 (ARH-2757(Pt.4)) RADIOACTIVE CONTAMINATION IN UNPLANNED RELEASES TO GROUND WITHIN THE CHEMICAL SEPARATIONS AREA CONTROL ZONE THROUGH 1972 (EXCLUSIVE OF LIQUID WASTE STORAGE TANK FARMS). Maxfield, H. L. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 3 Apr 1973. 11p. Dep. NTIS $3.00.

Data are summarized regarding sites containing unconfined radioactive materials resulting from unplanned releases to soil storage in the chemical processing area of the Hanford reservation from the time of plant start-up in 1944 through calendar year 1972. Each site is identified with the location, description, and history of the event as well as the amount and kind of radioactive material present. Included are spills, process transfer line leaks, informal burial sites, locations contaminated by airborne radioactive particulates, and spreads of radioactivity by animals. (CH)

10137 (CEA-CONF-2336) BEHAVIOR IN SUBTERRANEAN ENVIRONMENTS OF URANIUM AND THORIUM DISCHARGED BY THE NUCLEAR INDUSTRY. Rancon, D. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). [nd]. 17p. (In French). (CONF-730503-6; SM-172/55). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on environmental behaviour of radionuclides released in the nuclear industry; Aix-en Provence, France (14 May 1973).

A study was made of the behavior in the soil of uranium and thorium coming from exterior sources in contrast to the behavior of U and Th considered as natural constituents of the soil. Various types of soils (acid and alkaline) and various minerals (clay minerals, calcite, and quartz) were used. Uranium in solution, or more exactly the uranyl ion, has a certain mobility in the soils. The distribution coefficient of the uranyl ion between the solution and the mineral was measured at different concentrations. The effect of pH of the soil-water solution is very important and the retention of U by the soil increases sharply in certain pH regions. Thorium is very strongly retained by clay and limestone soils; certain soils fix it completely. The effect of various parameters (pH, concentration, soil composition) is also very important because the retention becomes very reduced under certain extreme conditions. The risk of propagation of Th in solution diluted over a long distance is negligible in the majority of terrains; on the contrary a certain diffusion of U under the influence of the movement of subterranean waters can be predicted. Evaluations of this diffusion are given. (tr-auth)

10138 EMANATION OF RADON AND THORON GASES FROM SOIL. Megumi, K.; Mamuro, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 35-37(Mar 1973).

A soil sample originating from weathering of granite was sieved into six kinds of particle size. The contents of natural radionuclides in each classified soil sample and the radon and thoron exhalation from it were measured. Both the contents of ^{226}Ra (parent nuclide of radon) and ^{224}Ra (parent nuclide of thoron) were found to consist of two components for the samples of more than 10 mesh; one is proportional to the total volume of soil particles and the other proportional to the total surface area of soil particles. On the other hand, the content of ^{40}K showed no remarkable variation with particle size. The thoron emanating power was found to be 30 to 40 percent. It was revealed that smaller soil particles have more contribution to the radon and thoron exhalation from the soil surface than larger soil particles. (auth)

Water

10139 (CEA-CONF-2223) FIXATION OF RUTHENIUM-106 ON VARIOUS TYPES OF SEDIMENTS. Guegueniat, P.; Le Gall, J. (CEA Centre de La Hague, 50-Cherbourg (France)). [nd]. 2p. (In French). (CONF-721146-3). Dep. NTIS (U.S. Sales Only) $3.00.

From 23rd meeting of the international commission for scientific exploitation of the Mediterranean sea; Athens, Greece (3 Nov 1972).

A laboratory study was made of the interaction in seawater of Ru with mud sediments samples along the Rance estuary. After three weeks of contact two forms were isolated: soluble forms representing 20 to 40% of the initial Ru and insoluble forms representing 20 to 30% of the initial Ru. A strong fixation of the Ru on the walls of the receptacle was noted. The hydrolyzed forms are rapidly fixed on the sediments, but the fixation of the soluble forms is only partial. One sample rich in iron oxide and devoid of carbonates fixed 91% of the Ru. (JSR)

10140 URANIUM IN THE CONTEMPORANEOUS SEDIMENTARY CYCLE OF THE SEA. Baturin, G. N. (Inst. of Oceanology, Moscow). Geokhimiya; No. 9, 1362-1372(Sep 1973). (In Russian).

During rocks weathering and in the river run-off, uranium is divided into the dissolved and the suspended one at an average 1:1

ratio. The average uranium content in the sum of dissolved and suspended matters of river run-off corresponds to its average content in the Earth crust; that determines uranium content in sea and ocean sediments. The share of hydrogenous uranium being concentrated in sediments of sea basins and the peripheric zones of the ocean up to (10 to 60) $\times 10^{-4}$% plays in the total balance a secondary role. This concentration is favored by the enrichment of sediments in organic matter and phosphorus, by the heightened uranium content in waters, by the reducing conditions near the boundary of water—bottom divide, by the slackened sedimentation rate, by the renewal of the near-bottom waters. Uranium transition from the solid phase to interstitial waters, where its concentration reaches $n \times 10^{-4}$ g/l, is a precondition of its redistribution during diagenesis. (auth)

10141 GEOCHRONOLOGICAL STUDIES IN SANTA BARBARA BASIN: ^{55}Fe AS A UNIQUE TRACER FOR PARTICULATE SETTLING. Krishnaswami, S. (Tata Inst. of Fundamental Research, Bombay); Lal, D.; Amin, B. S.; Soutar, A. Limnol. Oceanogr.; 18: No. 5, 763-770(Sep 1973).

Sediments accumulate in the Santa Barbara Basin relatively rapidly: about 3 to 4 mm yr^{-1} based on the analysis of varves. These deposits are ideal for studying the applicability of nuclear geochronological techniques in a natural situation. Studies of the depth distribution of several radionuclides, manmade ^{55}Fe and naturally occurring ^{210}Pb and Th isotopes, in recent Santa Barbara sediment layers permit an evaluation of the geochemical behavior of Fe, Pb, and Th in coastal waters and have established the usefulness of ^{55}Fe and ^{210}Pb for dating coastal or near coastal sediments deposited during the last decade and half-century respectively. (auth)

10142 RADON WATERS OF THE ROVNO REGION, THE UKRAINIAN SOVIET SOCIALIST REPUBLIC. Bilyk, N. A.; Dodin, A. V. Geol. Zh. (Russ. Ed.); No. 6, 101-104(Nov 1972). (In Russian).

Radon waters in the area of the city of Korets are limited to strongly fissured indigeneous crystalline rocks and their decomposition products. In these are formed water-bearing strata of the perched water table type, not exposed in course and depth. In the crystalline rocks at a depth of 40 to 90 meters, water fissures having a hydrostatic pressure are developed. The strata are fed by atmospheric pressure directly on the area of underground circulating water. The strata regime is irregular. Radon waters were studied in wells bored on the eastern outskirts of Korets, with a discharge of 100 m^3/hr. The radon concentration was 20.2 Mache units; the radium concentration was 0.97 to 2.33×10^{11} Ci/liter and the uranium, 1.93×10^{11} Ci/liter. The chemical composition of the water was that of low-mineral hydrocarbonate, calcium-magnesium waters, with 1.1 g of mineral salts per liter. Of the underground water outputs examined, interest was greatest in sources on the right-hand slope of Korchik Hill and limited to slightly fractured sulfurous granites. The radon content of the water was 14.1 to 18.0 Mache units (depending on the time of the year) for radium was $1.2 - 4.8 \times 10^{-11}$ Ci/liter, and for uranium was 1.65×10^{-11} Ci/liter. (tr-auth)

Ecosystems and Food Cycles

Refer also to abstracts 10160, 10166, 10486, 10495, 10496, and 12473.

10143 (BNWL-1783) RADIOECOLOGY OF IODINE-129: AN INTERIM REPORT. Soldat, J. K.; Brauer, F. P.; Cline, J. F.; Fager, J. E.; Klepper, B.; Rickard, W. H.; Vaughan, B. E.; Watson, D. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 80p. Dep. NTIS $5.45.

Radioactive isotopes of iodine are produced during nuclear fission in reactors and in weapons tests and to a limited extent in nature. Because of its extremely long half-life (1.6×10^7 yr), ^{129}I has the potential for accumulation in the environment from long-term, chronic releases from nuclear facilities. Possible problems associated with such an accumulation, including transfer of the ^{129}I through the biosphere and resultant radiation doses to man and other organisms are discussed. (70 references) (CH)

10144 (CONF-720692-, pp 125-142) PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS AT OAK RIDGE NATIONAL LABORATORY. Browning, W. E. Jr. (Oak Ridge National Lab., TN). [nd]

From 11th annual environmental and water resources engineering conference; Nashville, Tennessee, USA (1 Jun 1972).

Proceedings of the 11th annual environmental and water resources engineering conference, Nashville, Tennessee, June 1 – 2, 1972.

Some of the ORNL work on assessment of potential environmental impacts and on preparation of Environmental Impact Statements is described. The overall objectives of this work can be simply stated: to make sure that the design of nuclear power plants adequately protects our environment. The program was initiated in 1971 as a result of major changes in federal policies growing out of NEPA. (CH)

10145 (EPA-600/5-73-2) BIBLIOGRAPHY OF R AND D RESEARCH REPORTS. (Environmental Protection Agency, Washington, D. C. (USA). Office of Research and Development). Jul 1973. 101p.

On July 1, 1973 the former Office of Research and Monitoring was redesignated Office of Research and Development, Environmental Protection Agency (EPA). This bibliography records all research reports produced up to July 1, 1973, and supercedes EPA-R5-73-012, January 1973, Bibliography of REM Research Reports. Source information is included for procurement of these reports. (auth)

10146 (RFP-TRANS-141) REGULARITIES IN THE BIOGENIC MIGRATION OF URANIUM. Koval'skii, V. V.; Vorotnitskaya, I. E. Translated from Ukr. Biokhim. Zh.; 38: No. 4, 419-424(1966). 7p. Dep. NTIS $3.00.

Data are presented on the biogenic migration of uranium in a medium with elevated and normal content of this element. Biogenic migration under dry-land conditions was studied in the system: soil–plant–animals. It is shown that uranium concentration by soils depends on the type of soil and the forms of the uranium compounds. Under conditions of elevated uranium content in the environment, morphological variability was found in some plant species. The diurnal uptake of uranium by farm animals was computed. Biogenic migration of uranium under conditions of an aquatic environment was studied using Lake Ussyk-Kul, the waters of which contain an elevated concentration of this element. It is shown that the uranium content and gradient of its accumulation in organisms with respect to water diminishes when uranium passes through the chain: algae → benthic and planktonic animals → fish. (auth)

10147 COMPARATIVE STUDY OF THE EXPERIMENTAL CONTAMINATION OF SEAWATER AND FRESHWATER LAMELLIBRANCH MOLLUSKS WITH ^{137}Cs. Avargues, M. (CEN, Fontenay-aux-Roses, France); Foulquier, L.; Vilquin, A. Radioprotection; 8: No. 1, 19-32(1973). (In French).

Two Lamellibranch mollusks, a seawater one (Cadmium edule L) and a freshwater one (Anodonta cygned L) were contaminated with ^{137}Cs. The changes in the specific activity of the water and the mollusks were compared for the two environments. The role played by clearance processes in the aquatic environment was emphasized: other factors must be taken into account, in addition to the concentration factor, when comparing radioactivity uptakes in seawater and freshwater. (FR)

10148 NUCLEAR ENERGY AND THE ENVIRONMENT. Bresson, G. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 160-161(Jun 1973). (In French).

Particular emphasis is given by the Health Physics Department of the CEA to the study of the transfer of radioactive pollutants in the environment and food chains. Extensive equipment is available to research workers in the various laboratories. Data acquired on the human environment are particularly useful in agriculture. (FR)

10149 RADIOCONTAMINATION OF HUMAN FOOD CHAINS. Experimental Research with Large Domestic Animals. Nizza, P. (CEN de Saclay, Gif-sur-Yvette, France)); Daburon, F. Agriculture (Paris); No. 366, 170-174(Jun 1973). (In French).

Research was conducted on internal contamination of large domestic animals (bovine, ovine, and porcine) in order to obtain results applicable to man, and to study the contamination of milk and meat. The behavior in the animal organism of a given chemical element depends on the way in which it enters the organism. The nature of the contaminating radioisotope and its radioactive characteristics also affect its metabolism. Three contamination experiments with ^{131}I, ^{137}Cs, and ^{226}Ra are described. (FR)

10150 IRRIGATION: TRANSFER CHANNEL FOR RADIOACTIVE POLLUTION. Continental Radioecological Studies. Delmas, J.; Grauby, A. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 178-180(Jun 1973). (In French).

The spray irrigation of crops constitutes one of the ways in which radioisotopes such as ^{137}Cs and ^{90}Sr can be transferred to man. The transfer of radioisotopes in water courses was studied. The two ways in which vegetation can be contaminated by water are then reviewed: indirect contamination after the storage of radionuclides in the ground and direct aerial contamination. The results obtained in the second case are examined in terms of the absorption and distribution in plants and the consequent risks to health. An estimation is then given of the amount of contamination in the daily food ration and the transfer of radio-

active pollutants within the site in which the nuclear industries are located. (FR)

Radiometric Techniques

Refer also to abstracts 10255 and 10874.

10151 MASS DETERMINATION OF PLANTATIONS BY ABSORPTION OF GAMMA RADIATION. Kuehn, W.; Schaetzler, H. P. (Gesellschaft fuer Strahlen und Umweltforschung mbh, Hanover). Atomkernenergie; 21: No. 2, 141-144(1973).

A scanning method is reported by which the mass of an entire plantation can be determined. The field in question is scanned continuously or discontinuously by a suitable γ radiation. A computer reduces the data of each single measuring interval to weights per unit area, adds them, and calculates the total mass. For this purpose, the correlation between the observable measuring values of the weight per unit area and its coordinates and the given parameters is derived. The parameters concerning the absorption measurement are dealt with. An analytical expression for the total mass shows in which manner the measured values must be handled. The method is extended to a separate mass determination of single parts of the plants. Statistical problems encountered in discontinuous measurement are discussed. (GE)

10152 FISSION-TRACK AGES OF TUFFS OF THE NEOGEN TERTIARY IN OGA PENINSULA, AKITA PREFECTURE, JAPAN. Nishimura, S. (Kyoto Univ.); Ishida, S. Ganseki Kobutsu Kosho Gakkaishi; 67: No. 5, 166-168(May 1972). (In Japanese).

10153 ^{14}C DATING BY LIQUID SCINTILLATION COUNTING ON SYNTHESIZED METHANOL AND ITS APPLICATION ON WOODEN REMNANTS IN EJECTA OF THE FUJI VOLCANO. Yamada, O. (Kyoto Sangyo Univ.); Wada, H.; Sameshima, T. Chishitsugaku Zasshi; 78: No. 5, 235-239(May 1972). (In Japanese).

Methanol is synthesized from wooden remnants using $LiAlH_4$. Sample charcoal is burned in an oxygen current and the CO_2 gas formed is blown into diethyleneglycol diethyl ether (Diethyl carbitol) with dissolved $LiAlH_4$. Then the lithium aluminum methoxide formed is decomposed by diethyleneglycol monobutyl ether (Butyl carbitol) into methanol and lithium aluminum alkoxide. Eight grams of synthesized methanol mixed with scintillator is set in a liquid scintillation counter and the β decay of ^{14}C is counted. Fourteen samples of wooden remnants from different parts of the Fuji volcano were analyzed for their ^{14}C age. Seven items are described for each sample: locality, mode of occurrence, state and species, collector and the time, ^{14}C age determination, code number, and other remarks. Among the 14 samples, two from ejecta of A.D. 864 or 1,086 y.B.P. were measured for their age as 1,040 ± 80 and 1,000 ± 80 y.B.P., and ten samples from more recent ejecta were measured between 1,070 ± 60 to 3,610 ± 100 y.B.P. The remaining two samples from the older mud flow of Fuji volcano were measured as 17,700 ± 300 and 18,500 ± 300 y.B.P. (auth)

10154 GROUND WATER: EXPERIMENTS WITH ISOTOPES. Moser, H.; Neumaier, F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). Umsch. Wiss. Tech.; 73: No. 16, 501-502(1973). (In German).

A rough survey on the use of artificial radioactive tracers and environmental isotopes (deuterium, tritium, oxygen-18, carbon-14) in hydrology shows the increasing importance of such methods for all kinds of hydrological studies. (GE)

Site Surveys

Refer also to abstracts 10103 and 12397.

10155 (ARH-1837) MANAGEMENT OF THE HANFORD WATER TABLE AND WASTE MANAGEMENT IMPLICATIONS. Tomlinson, R. E.; Isaacson, R. E.; Brown, D. J.; Veatch, M. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 21 Sep 1970. 43p. Dep. NTIS $4.25.

The geology and hydrology of the Hanford Reservation are reviewed, with emphasis on ground water flow, to identify those areas that should be restricted from unconditional release due to radionuclide contamination or radioactive waste storage as well as those areas that would have no hydrological restrictions. The effects of the discharge of large quantities of cooling water from the radiochemical plants on ground water flow were also evaluated. (CH)

10156 (ARH-2214) ANTICIPATED EFFECT OF DISCHARGING 242-S EVAPORATOR COOLING WATER TO THE GROUND. Veatch, M. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 17 Sep 1971. 15p. Dep. NTIS $3.00.

The discharge of cooling water, in the amount of 1 to 1.2 billion gallons per year for a period of three years, from the 242-S Evaporator-Crystallizer to the groundwater system will have a measurable effect on the altitude of the water table beneath and directly adjacent to the 200 West Area of the Hanford Reservation. The probability is high that the water levels in well 299-W23-4 and well 699-35-78 adjacent to the 216-U-10 pond will rise from their present altitude of 478 feet to a minimum altitude of 500 feet, a water-table rise of 22 feet. Furthermore, a maximum water-table altitude of 510 to 515 feet may be realized in the above-mentioned wells because the sediments above a general altitude of 500 feet become finer textured and, therefore, possess a lower water transmitting capability. This resultant water-table rise is of a local nature when considered in relation to the physical boundaries of the regional groundwater system beneath the Hanford Reservation. Based on an average pore volume of 25 percent, total infiltration of three billion gallons and an average rise in the water table of one foot, the area affected would be described by a 4.3 mile radius circle; if a 25 foot rise resulted the radius of the area affected would be about 4500 feet. The historical rise of the water table beneath and adjacent to the 200 Area Chemical Separations Facilities has been monitored since 1944. This monitoring program has provided the hydrogeologic data (drillers' logs, bore hole samples, and water-level measurements) upon which the analysis is based. (auth)

10157 (ARH-2610) GEOCHEMICAL VARIATION OF COLUMBIA RIVER BASALTS BENEATH THE HANFORD RESERVATION, WASHINGTON. Tatman, J. B. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 30 Sep 1972. Contract AT(45-1)-2130. 66p. Dep. NTIS $5.50.

Major element and trace element analyses of Columbia River basalts have been compiled to indicate where geochemical changes occur in the stratigraphy of the basalts. The analyses were averaged and plotted on petrologic variation diagrams to elucidate geochemical trends and correlations. This report is concerned mainly with the major elements. (auth)

10158 (BNWL-1790) RAPTORIAL BIRDS OF THE U.S.A.E.C. HANFORD RESERVATION, SOUTH-CENTRAL WASHINGTON. Olendorff, R. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-1830. 48p. Dep. NTIS $4.00.

Over 50 nesting pairs of raptorial birds were found on the U. S. Atomic Energy Commission's Hanford Reservation in south-central Washington during 17 man-days afield in 1973. (auth)

10159 (BNWL-B-237) RADIATION SURVEY OF WAHLUKE SLOPE. Bramson, P. E.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Dec 1972. Contract AT(45-1)-1830. 13p. Dep. NTIS $3.00.

A radiation survey was made of the Wahluke Slope area of the Hanford project. Thirty-eight sites were picked on Wahluke Slope primarily by geographical location so as to blanket the entire slope except for the control zone lying within 5.5 miles of N-Reactor and reactors on stand-by status. At each of these sampling sites, surface soil and vegetation samples were obtained for analysis. Contamination, exposure rate, and cumulative dose measurements were made during the months of September and October, 1972, at each site. Contamination surveys of about 60 miles of improved roads (graded or surfaced) in the Wahluke Slope area were performed using a vehicle-mounted road monitor. Groundwater was sampled at nine widely dispersed wells on the slope. Radionuclide concentrations at the sampling sites on Wahluke Slope were typical of regional fallout except along the Columbia River bank where activation products from Hanford reactor cooling water could be detected. Average measured exposure rate on Wahluke Slope was 0.33 mR/day compared to a calculated value of 0.27 mR/day for cosmic radiation and naturally occurring radionuclides only. Average exposure rate for four sites along the Columbia River was 0.42 mR/day. Survey of more than 60 miles of improved roads on Wahluke Slope with a contamination monitor revealed only nominal background radiation levels. Radionuclide and chemical concentrations in nine Wahluke Slope wells did not appear to be affected by Hanford operations. (auth)

10160 (CEA-CONF-2443) TRANSFER MECHANISMS IN CULTIVATED SOILS OF WASTE RADIONUCLIDES FROM ELECTRONUCLEAR POWER PLANTS IN THE SYSTEM RIVER–IRRIGATED SOIL–UNDERGROUND WATER LEVEL. Saas, A.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Protection). 1973. 20p. (In French). (CONF-730503-9; SM-172/57). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on environmental behavior of radionuclides released in the nuclear industry; Aix-en-Provence, France (14 May 1973).

The location of nuclear power plants by rivers whose waters are

used for irrigation and industrial and domestic consumption necessitates a profound study of the river-irrigated soil-ground water system. Mechanisms of radionuclide transport in cultivated soil are considered under three principal aspects: the effect of the quality of the river water, of the irrigation channels, and of the ground water level on the mobility of the radionuclides in the soil; the influence of the type of soil (the four types of soils considered are acid brown soil, calcic brown soil, chalky brown soil, and chalky alluvial soil); and the distribution of radionuclides in the soil (hydrosoluble forms can contaminate the ground water level and these are the forms in which they are taken up by plants. A study was made on the following nuclides: ^{22}Na, ^{137}Cs, ^{85}Sr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{65}Zn, ^{124}Sb, ^{141}Ce, and ^{131}I. The transfer mechanisms in the cultivated soils permit the evaluation of the risks of contamination of the food chain and of the underground water. This study also showed new perspectives of the behavior of radionuclides as a function of their contamination of the organo-mineral wastes of industrial and domestic origin. This pollution interfers largely with the formation of stable complexes carried by the river to irrigated soils. The quality of the water determines the distribution of the radionuclides in the profile. The hydrosoluble complex persists in the soil and migrates toward the underground water level if they are not biodegradable. The stability of these forms as a function of the soil pH and of its physicochemical characteristics, as well as that of the radionuclides considered, permit the formulation of a new balance of the radionuclides in soils. The formulation of new proposals for the control of nuclear sites is discussed. (tr-auth)

10161 (HW-51030(Rev.1)) BIBLIOGRAPHY OF THE GEOLOGY OF SOUTH CENTRAL WASHINGTON AND PERTINENT ADJACENT AREAS. Brown, R. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 1 Jul 1959. 24p. Dep. NTIS $3.25.

A list is presented of 283 references published up to 1959 pertinent to an understanding of the geology of the Pasco Basin and the geology and hydrology of the Hanford area relevant to the disposal of radioactive liquid wastes. (CH)

10162 (HW-62530) SURFACE OF THE RINGOLD FORMATION BENEATH THE HANFORD WORKS AREA. Brown, R. E. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 17 Mar 1960. 13p. Dep. NTIS $3.00.

Two major geologic units at Hanford contain the bulk of the materials into which radioactive liquid wastes are discharged, in which the waste products are retained, and through which they and the ground waters move. These are the Pleistocene Ringold formation and the Recent glaciofluviatile and fluviatile sediments. Distinction between the Ringold formation sediments and the Recent fluviatile gravels on the basis of properties affecting waste behavior rather than, as more commonly, predominantly on lithologic, stratigraphic, or paleontologic grounds, emphasizes the importance of formation distinction at Hanford. These data, geologically correlated to the lithologic evidence, indicate that the surface of the Ringold formation is extensively and irregularly eroded. The irregular surface was formed by the Columbia River prior to deposition of the Recent fluviatile gravels. A network of river channels crosses the Hanford areas and dissects what was evidently an earlier extensive erosional or land surface sloping gently from the hills toward the Columbia River. Many of the channels now bottom beneath the current ground water table. Where this occurs ground water flow toward the Columbia River is at least potentially at quite rapid rates through the highly permeable fluviatile gravels. Recognition of the presence of the channels permits monitoring wells to be located better where the most rapid ground water flow occurs and where contaminants may be moving rapidly toward the Columbia River. Disposal operations can be conducted better to minimize the presence and effect of those channels and still further improve and assure the safety of Hanford's disposal operations. (auth)

10163 (USGS-474-175) TECHNIQUES FOR THE QUANTITATIVE DETERMINATION OF ALLUVIAL PHYSICAL PROPERTIES FROM GEOPHYSICAL LOGS, SOUTHERN YUCCA FLAT, NEVADA TEST SITE. Carroll, R. D.; Muller, D. C. (Geological Survey, Denver, Colo. (USA)). Nov 1973. Contract AT(29-2)-474. 113p. Dep. NTIS $5.45.

An analysis of geophysical logs and core data from four drill holes that penetrate saturated alluvium in Yucca Flat at the Nevada Test Site indicates that the resistivity of saturated alluvium (R_0) is related to the porosity (ϕ) by the equation, $R_0 = 5.10\ \phi^{-1.76}$. Assuming that the exponent in the saturation equation ($R_0/R_t = S_w^n$, is the same as in the former relationship results in a prediction equation for water content by weight (W) of the form $W = (2.52\ R_t^{-0.562})/D_b$ where D_b is the observed alluvium density and R_t is the electrical resistivity. Values of (W) from 208 tests on core obtained from Christensen rubber sleeves in 11 exploratory holes in southern Yucca Flat have a correlation coefficient of 0.8 with values of (W) obtained from the empirical equation using data from geophysical logs. On the basis of these relationships interpretation charts and field examples are presented for deriving alluvial properties from geophysical logs in situations where the hole is drilled with airfoam or mud. Examples of interpretation involving large-diameter holes (exceeding 4 feet in diameter) as well as those of normal dimension are treated. Grain densities are required to complete most of the interpretations discussed, and present data indicate that values of either 2.53, 2.60, or 2.45 g/cc are applicable over large vertical sections of the alluvium. The choice of the appropriate value depends on the relative amounts of volcanic tuff and carbonate or quartzite rock present in the area of concern. In Areas 3 and 7 in Yucca Flat, 2.53 g/cc is most representative. The derived relationships indicate that water contents in excess of 20 percent by weight cannot exist in alluvium that exhibits a resistivity in excess of about 60 ohm-m. The possible presence of clay makes the converse of this untrue, and when alluvial resistivities are 40 ohm-m or less a neutron-log interpretation is considered desirable to supplement the resistivity method. Examples of interpretation are presented in detail. (auth)

Thermal Effluents

Refer also to abstracts 10125, 11858, 12035, 12135, and 12212.

10164 (CONF-720692-, pp 13-26) TWO-DIMENSIONAL TEMPERATURE MODEL FOR A THERMALLY LOADED RIVER WITH STEADY DISCHARGE. Yotsukura, N. (Geological Survey, Washington, DC). [nd].

From 11th annual environmental and water resources engineering conference; Nashville, Tennessee, USA (1 Jun 1972).

Proceedings of the 11th annual environmental and water resources engineering conference, Nashville, Tennessee, June 1-2, 1972.

Waste heat released into a river is attenuated mostly by the natural processes of mixing with cold ambient water and dissipation from water surface to air. A model is presented in which the excess temperature distribution is calculated by combining analytical solutions to an approximate convective diffusion (mixing) equation with an exponential heat dissipation equation at the air-water interface. Both river discharge and waste discharge are assumed steady. The model is useful in predicting distribution of excess temperature in a downstream region where temperature is almost uniform in the vertical direction while it is still markedly nonuniform in the transverse direction. (auth)

10165 (HW-80888(Del.)) EFFECTS OF HANFORD OPERATIONS ON COLUMBIA RIVER TEMPERATURES. Interim Report No. 2. Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 3 Dec 1964. 93p. Dep. NTIS $6.75.

Declassified 28 Jul 1970.

Progress is reported on the study of the effects of Hanford reactor effluent on Columbia River quality. Investigations were started to determine the net reactor heat effect on overall river temperatures and data were collected on the accuracy of existing temperature measurements at the same locations, heat losses from the effluent between the reactors and the river, effluent travel times, and the adequacy of meteorological data collected at the cooling tower for use along the river. A statistical analysis was made of overall river temperature changes at specific locations during a 12-month period. Progress was also made in the determination of local effluent concentrations and in investigations on the possibility of estimating reactor power levels from off-site measurements. (CH)

10166 (SAN-807-X-3) STUDIES ON THE PHYSICAL PROCESSES OF HEAT AND GAS EXCHANGE IN THE RED MANGROVE ECOSYSTEM. Interim Report and Proposal, July 1, 1973-June 31, 1974. Miller, P. C. (San Diego State Univ., Calif. (USA). Dept. of Biology). 1973. Contract AT(04-3)-807. 11p. Dep. NTIS $3.00.

A model was developed of heat and CO_2 exchange and primary productivity during photosynthesis by vegetation canopies of red mangrove. The model was used to estimate the effects of thermal effluents on the daily course of plant photosynthesis in three mangrove species. (CH)

10167 (UCID-16377) HIGH-PRESSURE MECHANICAL PROPERTIES OF AN AREA 12, NEVADA TEST SITE TUFF. Duba, A.; Abey, A. E.; Heard, H. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1973. Contract W-7405-Eng-48. 21p. Dep. NTIS $3.25.

The mechanical properties of tuff from instrument hole UG3, tunnel U12e.06 at the Nevada Test Site have been investigated to

1400 MPa. The shear strength increases from about 5 MHa unconfined to 12 MPa at 300 MPa mean pressure. A brittle-ductile transition was indicated at about 280 MPa. In uniaxial strain, the sample loads to the vicinity of the failure envelope and then is parallel to that envelope up to the highest stresses, 420 MPa. Hydrostatic pressure of 1400 MPa produces about 9% volume compression and 1.3% permanent compaction in this apparently saturated tuff. (auth)

Chemical Effluents

Refer also to abstracts 10120, 10125, 12376, and 12472.

10168 (CONF-720692 -, pp 183-198) SO_2 CONTROL FROM POWER PLANT FLUE GASES. Hollinden, G. A. (Tennessee Valley Authority, Chattanooga). [nd].

From 11th annual environmental and water resources engineering conference; Nashville, Tennessee, USA (1 Jun 1972).

Proceedings of the 11th annual environmental and water resources engineering conference, Nashville, Tennessee, June 1–2, 1972.

The role of the fossil-fuel-burning, thermal power plant as a major source of SO_2 emission in the United States is discussed. The data indicate that 20 million tons of the total of 36.6 million tons SO_2 emission (about 55 percent) from stationary sources in 1970 was from fossil plants. If uncontrolled, the total SO_2 emission is expected to peak after the year 2000 at about 120 million tons per year, with thermal power plants accounting for 75 percent of this total. Because of the increasing research and development attention that has been given to this problem over the past five years, the technology to control the emission of SO_2 is probably better understood than the technology for controlling other major gaseous air pollutants. Nevertheless, even while regulatory agencies are setting national and regional standards for SO_2 control, the engineering technology presently available to the electric utility industry to attain these goals on a production basis is inadequate for the task. Two basic options possibly exist for control of sulfur dioxides from power plants, the use of clean fuels and flue gas desulfurization. Because of the limited supply and high cost of low-sulfur fuels and the need to use these fuels for more-difficult-to-control sources, it will be impossible for many power plants to adopt this control procedure. Artificially produced clean fuels (gases, liquids, or solids produced from coal) are an interesting possibility, but proven industrial technology for producing such fuels will require several years, possibly a decade or more, for true commercialization and use. At least for the near term, it will be necessary for many power plants to install flue gas desulfurization processes. The list of desulfurization processes and variations on processes is quite long. Of this group, only about four can be rated as having sufficient promise or having been developed to the point of being classified as first-generation processes. The efficiency of dry limestone injection, wet lime/limestone scrubbing, magnesium oxide scrubbing, and catalytic oxidation is compared. (auth)

10169 DILUTION SAMPLING SYSTEM FOR GASEOUS POLLUTANTS. Rodes, C. E. (National Environmental Research Center, Research Triangle Park, NC). Instrum. Technol.; 20: No. 10, 41-44(Oct 1973).

To reduce problems associated with continuous monitoring of pollutant gases, an improved sample handling system was developed at an EPA laboratory. By means of a special probe and a flow control loop to which a gas monitor is connected, this interface system dilutes the stack gas in a controlled ratio, thus lowering the dewpoint and reducing the particulate concentration in the sample stream to the analyzer. (auth)

10170 REMOVAL OF SO_2 FROM LOW SULFUR COAL COMBUSTION GASES BY LIMESTONE SCRUBBING. Nannen, L. W.; West, R. E.; Kreith, F. (Univ. of Colorado, Boulder). J. Air Pollut. Contr. Ass.; 24: No. 1, 29-39(Jan 1974).

An analysis of the limestone scrubbing process for SO_2 removal was carried out. It was found that low concentrations of SO_2 in power plant flue gas (<1,000 ppM) tend to minimize the solid–liquid mass transfer resistance, and the SO_2 absorption process approaches gas phase control. Gas phase control has a favorable effect on the important parameters of limestone blinding, scaling, slurry pH stability, sulfite oxidation, solids settling, and slurry recirculation rate. It is concluded that operational reliability increases for lower SO_2 gas concentrations. A discussion of scrubber designs and corresponding mass transfer coefficients for limestone scrubbing is given, and a process design procedure is presented. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 10504.

General Detectors and Monitors

Refer also to abstracts 10575, 10769, 10802, 10863, 11414, 11682, 11880, 11930, 11948, and 12069.

10171 (AERE-R-6935) THERMAL DIFFUSION OF LITHIUM INTO HIGH PURITY SINGLE CRYSTAL SILICON. Knill, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Oct 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

A system is described for evaporating lithium metal on to silicon and forming by diffusion an n^+ layer to serve as a junction contact and dopant source for lithium compensation by the lithium-ion drift technique used for fabricating thick depletion depth radiation detectors. Junction depth and sheet resistance of n^+ layers obtained after a 10 minute diffusion at temperatures between 290 and 410°C are given. The relationship between these parameters provide a simple nondestructive method of checking junction depth after a thermal diffusion has been carried out. (auth)

10172 (CISE-N-163) STUDY AND CONSTRUCTION OF Ge(Li) DETECTORS. Part 1. Capelli, A.; Masini, M.; Redaelli, G. (Centro Informazioni Studi Esperienze, Milan (Italy)). Sep 1973. 36p. Dep. NTIS (U.S. Sales Only) $4.00.

The development of semiconductor detectors has made possible the realization of high-quality γ spectrometers consisting of germanium diodes with NIP junction. The efficiency of these detectors is actually quasi-competitive with that of classical NaI(Tl) spectrometers whereas their resolving capacity is substantially higher. This has caused a significant development in γ spectrometers. The construction techniques and the operational characteristics of flat Ge(Li) detectors, developed at the CISE, are described. (tr-auth)

10173 (FEI-309) MEASUREMENT OF FISSION CHAMBER EFFICIENCY USING THE METHOD OF UNCORRELATED NEUTRON BACKGROUND. Dulin, V. A.; Mozhaev, V. K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 8p. (In Russian). INIS.

The time dependence of the fast neutron background was used for the determination of the efficiency of ^{252}Cf fission chambers. The magnitude of $1-\epsilon_f$ was measured directly in the experiment but not the efficiency of the chamber as this is done by other current methods. If the efficiency of the fission chamber is close to unity, the precision of the chamber efficiency of ~0.1 + 0.2% can be obtained. The fast fission chamber with layers of ^{252}Cf was irradiated with a neutron source. The neutrons were registered with stilbene scintillators with discrimination of γ rays. The efficiency of this fission chamber was measured by the n-f coincidence method. (tr-auth)

10174 (IPR-DR-39) PORTABLE GEIGER COUNTER WITH LOGARITHMIC SCALE. Oliveira, L. A. C.; de Andrade Chagas, E.; de Bittencourt, F. A. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil). Divisao de Restores). Jun 1971. 3p. (In Portuguese). INIS.

From 23rd annual meeting of the Brazilian Society for the Advancement of Science; Curitiba, Brazil (4 Jul 1971).

A portable scaler with logarithmic scale covering 3 decades: 1 to 10, 10 to 10^2, and 10^2 to 10^3 cps is presented. Electrical energy is supplied by 6 volts given by 4 D type batteries. (INIS)

10175 (LBL-2419) MULTIWIRE PROPORTIONAL CHAMBER FOR IMAGING THERMAL, EPICADMIUM, AND FAST NEUTRONS. Valentine, K.; Kaplan, S.; Perez-Mendez, V.; Kaufman, L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 6p. (CONF-731112-21). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The 25 cm × 25 cm chamber described images thermal and epicadmium neutron beams using two boron-coated conversion screens, and fast neutrons using a single polyethylene converter. Sample images and quantitative attenuation and resolution data are presented. Measurements of neutron attenuation in lucite patterns give good agreement with expected values for thermal, epicadmium, and fast (Pu–Be) beams. The measured mean free paths were 0.30, 0.81, and 5.8 cm, respectively. Thermal neutron resolution (0.2 cm) depends upon α-particle range, but resolution for fast neutrons (0.4 cm) appears to be limited by chamber thickness (to approximately one-half of the chamber thickness). Measurements involving digital image storage and manipulation are also described and illustrated. (auth)

10176 (LURI-1973-5) WHOLE-BODY COUNTER: CALIBRATION ^{137}Cs AND POTASSIUM IN CHAIR GEOMETRY. Carlsson, S.; Liden, K. (Lund Univ. (Sweden). Radiofysiska Institutionen). Aug 1973. 5p. (In Swedish). Dep. NTIS (U.S. Sales Only) $3.00.

The calibration of a whole-body counter has been done in connection with installation of a new detector, a NaI(Tl)-crystal. Calibration for measurements of ^{137}Cs has been done with ^{132}Cs. The energy of the γ-radiation of ^{132}Cs agrees very well with that of ^{137}Cs. ^{132}Cs has been prepared through irradiation of CsCl in a betatron. The determination of the activity of ^{132}Cs was performed with a 7.6 cm × 7.6 cm NaI(Tl)-crystal within lead walls. The ^{132}Cs-solution was mixed with water and poured into a phantom. 100 minute measurements were performed. The same procedure was done with KCl. A calibration constant is given for whole-body measurements of ^{137}Cs and the accuracy is discussed. (SW)

10177 (SLAC-Trans-158) CALCULATION OF THE CURRENT IN AN IONIZATION CHAMBER IN A PULSED ELECTROMAGNETIC FIELD AND COMPARISON WITH MEASUREMENTS. Application to Radiation Monitoring in Electron Storage Rings. Dinter, H.; Tesch, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Oct 1973. Translation of DESY-73-22. 46p. Dep. NTIS $4.50.

The charge concentration in an ionization chamber exposed to an electromagnetic field is calculated up to moderately high dose rates. From this the ionization current is derived for continuous radiation fields, for pulsed radiation fields with low and high repetition rates, as well as for a single radiation pulse. The calculations are checked with an argon-filled chamber for pressures between 1 and 50 atmospheres, average dose rates up to 10 rad/h, and repetition rates between 1 and 50 Hz (duty cycles between 2×10^{-4} and 1×10^{-4}). Without the use of a free parameter an agreement better than 20% on average is achieved. The suitability of the chamber for radiation survey at the DORIS storage ring is discussed. (auth)

10178 PREPARATIVE ERROR SOURCES IN LIQUID SCINTILLATION MEASUREMENT OF BIOLOGICAL SAMPLES. Lendvay, J. (Fovarosi Kozegeszsegugyi es Jarvanyugyi Allomas, Budapest); Pertik, B. N.; Nagy Eva, J. Izotoptechnika; 16: No. 9, 512-520(Sep 1973). (In Hungarian).

Factors that decrease color, chemical extinction, and chemical luminescence in liquid scintillator measurements in biological samples are considered. (auth)

10179 HEAVY-ION INDUCED SECONDARY ELECTRON EMISSION: A POSSIBLE METHOD FOR Z-IDENTIFICATION. Clerc, H. G.; Gehrhardt, H. J.; Richter, L.; Schmidt, K. H. (Technische Hochschule, Darmstadt, Ger.). Nucl. Instrum. Methods; 113: No. 3, 325-331(1973).

A system is described for the detection of secondary electrons which are emitted when ions pass through foils. The yield of secondary electrons from one and two carbon foils, each being about 6 $\mu g/cm^2$ thick, was measured for ions in the 1 MeV/nucleon range as a function of the atomic number Z and the velocity of the ions. Due to the influence of high energy δ-rays, the yield from two foils is more than twice as high as that from one foil and it is highly Z-dependent. When using two foils instead of one, the relative half width of the frequency distribution of the number of secondary electrons is reduced because of the improved statistics. It should, therefore, be possible to apply a secondary electron detector with many foils for the Z-identification of heavy ions in a similar way as a dE/dx-detector. (auth)

10180 CHARGE COLLECTION IN SILICON DETECTORS FOR STRONGLY IONIZING PARTICLES. Seibt, W.; Sundstroem, K. E.; Tove, P. A. (Uppsala Univ.). Nucl. Instrum. Methods; 113: No. 3, 317-324(1973).

Experimental results for the plasma time in a semiconductor detector are given for alpha-particles, ^{16}O ions and fission fragments. The plasma time t_p is defined as the time needed to bring all carriers under the influence of the applied field. A simple theoretical model based on diffusion and space charge limited current erosion of the track is described and results in the expression $t_p = 1.32 \times 10^{-10} (n_l E)^{\frac{1}{2}}/F$ for a silicon detector where F is the electric field in the detector at the position of the track, n_l is the linear carrier density in the track and E is the particle

energy. This gives good agreement with the experimental data for tracks longer than ≈15 μm (alphas and ^{16}O ions of energies 5.3 to 8.8 MeV and 22 to 42 MeV, respectively). The shorter tracks of fission fragments (90 MeV from ^{252}Cf) give shorter t_p values than predicted by the formula above. This is explained by transfer from cylindrical to spherical erosion geometry. (auth)

10181 LOGARITHMIC CHARGE AMPLIFIER FOR SCINTILLATION DETECTORS. Radeka, V. (Brookhaven National Lab., Upton, NY). Nucl. Instrum. Methods; 113: No. 3, 401-412(1973).

A logarithmic system is described in which a new fast logarithmic converter is employed. An accurate logarithmic response over five decades has been achieved with this system. Operating conditions of the photomultiplier are optimized so as to achieve a large dynamic range with linear response. The fast logarithmic converter is a current-to-voltage converter based on the exponential dependence of the collector current on the base-emitter voltage of the bipolar transistor. High speed is achieved by a circuit configuration which employs a transconductance amplifier instead of a conventional operational amplifier. The signal charge is measured indirectly by measuring the current discharged from the capacitance of the anode of the photomultiplier into the logarithmic current amplifier. The rise time is standardized for the whole dynamic range to about 0.3 μ-sec by using an R-C-R-T-network between the anode of the photomultiplier and the input of the logarithmic amplifier. The recovery time is determined by this network, and it is 2.4 μsec per decade. The charge range of the amplifier is from 10^{-14} to 3×10^{-9} C. The equivalent noise of the amplifier is less than 10^{-15} C. (auth)

10182 MECHANICAL RESONANCE DETECTOR FOR MULTIWIRE PROPORTIONAL CHAMBERS. Chase, R. L. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 113: No. 3, 395-399 (1973).

The mechanical tension in the anode wires of a multiwire proportional chamber must be sufficient to prevent wire displacement due to electrostatic forces between wires but must not exceed the breaking strength of the wires. A technique is described for inferring the tension by measuring the mechanical resonant frequency of the wires. It employs a servomechanism which uses the small capacitance change of the selected wire to tune a variable frequency oscillator to the mechanical resonance. Since it is not necessary to observe the wires visually, the technique is applicable to closed chambers in inaccessible locations. (auth)

10183 HIGH-ACCURACY, TWO-DIMENSIONAL READ-OUT IN MULTIWIRE PROPORTIONAL CHAMBERS. Charpak, G.; Sauli, F. (European Organization for Nuclear Research, Geneva). Nucl. Instrum. Methods; 113: No. 3, 381-385(1973).

By measuring the center of gravity of the pulses induced on cathode strips in a multiwire proportional chamber it is shown that a good two-dimensional accuracy can be reached, of the order of 150 μm. Applications for two-dimensional read-out in drift chambers or low energy x-ray mapping are discussed. (auth)

10184 FAST CHARGE-SENSITIVE PREAMPLIFIER FOR SOFT X-RAY ASTRONOMY APPLICATIONS OF MULTIWIRE PROPORTIONAL CHAMBERS. Auriemma, G.; Giovannelli, F.; Mengucci, C. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Nucl. Instrum. Methods; 113: No. 3, 473-475(1973).

An inexpensive charge-sensitive preamplifier circuit with total dissipation of 38 mW and sensitivity of 3.2×10^{-6} volts/electron has been developed and tested for a soft X-ray multiwire proportional chamber. (auth)

10185 PHOTOCHROMIC MATERIALS AS RADIATION DETECTORS. Ouseph, P. J.; Groskreutz, H. E. (Univ. of Louisville, KY). Nucl. Instrum. Methods; 113: No. 3, 469-471(1973).

Mechanisms responsible for color changes in these crystals are discussed in terms of their use for detecting radiations. (auth)

10186 X-RAY AND GAMMA-RAY SCINTILLATORS AND DETECTOR SCREENS INCORPORATING SAME. Driard, B. M.; Guyot, L. F.; Roziere, G. (to Thomas-CSF). US Patent 3,769,059. 30 Oct 1973. Priority date 30 Dec 1969, France. 6p.

An x-ray or gamma-ray scintillator comprising, on a substrate, an alkaline halide layer of fibrous structure having the needle form, with the needles perpendicular to the surface of the substrate, is described. The scintillator is used in detector screens of image-intensifier tubes for x-ray or gamma-ray detection with a photo-sensitive-layer enshrouding the needles. (8 Claims, 3 Drawing Figures) (Official Gazette)

10187 HIGH RESOLUTION RADIOACTIVITY DISTRIBUTION DETECTION SYSTEM. Grenier, R. P.; Jacobson, E. B. (to Baird-Atomic Inc.). US Patent 3,777,142. 4 Dec 1973. Filed date 8 Jul 1971. 8p.

Radiation emitted from a subject positioned on a programmable X,Y platform is detected by means of an array of sensing devices. The platform, which is in spaced relationship with the subject, is moved along its X and Y axes in incremental steps defining a programmed scanning pattern, each step being an integral multiple of the distance between adjacent sensing devices. The radioactive events, which are detected at each step, are temporarily held in a memory and then stored on a recording medium. Upon completion of the programmed scanning sequence, the stored data which represents the radioactivity detected at each step is recalled from the recording medium and applied to a display via the memory for presentation as a combined pictorial representation of the detected radioactive events at each step. (13 Claims, 9 Drawing Figures) (Official Gazette)

10188 ATTENUATED LIGHT COUPLING BETWEEN SCINTILLATOR AND PHOTOMULTIPLIER. Lange, K. (to Nuclear Data (Ireland) Ltd.). US Patent 3,774,032. 20 Nov 1973. Filed date 22 Oct 1971. 6p.

A radiation image device having a scintillator, a plurality of photomultiplier tubes positioned to receive light from the scintillator and a light conductor between the scintillator and the photomultiplier tubes is described. Dimming means are positioned between the scintillator and photomultiplier tubes. (8 Claims, 2 Drawing Figures) (Official Gazette)

10189 IMPROVED APPARATUS FOR OBTAINING IONIC MOBILITY DISTRIBUTIONS OF RADIOACTIVE AEROSOLS. Nakatani, S. (Electrotechnical Lab., Tokyo). J. Meteorol. Soc. Jap.; 50: No. 3, 151-158(Jun 1972).

A new design for the measurement of the ionic mobility distributions of naturally occurring radioactive aerosols is described. The main features include novel means for obtaining the time variations of mobility distributions. The apparatus is a cylindrical aspiration chamber having an inner electrode consisting of a thin wall gas flow counter. The charged radioactive aerosols are trapped along the axis of electrodes by the radial field between two concentric cylinders. The distribution of radioactivity deposited along the inner electrode is obtained by changing the effective length of the counter. The procedures of experiments and practical treatments of data analysis are described. (auth)

10190 COMMERCIAL GRADE ALUMINUM: A VERSATILE REACTOR FLUX MONITOR. Parekh, P. P.; Heimann, M. (Univ., Cologne). J. Radioanal. Chem.; 14: No. 2, 357-365(Apr 1973).

With the advent of Ge(Li) spectrometry, a high standard of purity for neutron flux monitors no longer remains an imperative "must" and becomes rather superfluous. From this standpoint, commercial grade Al was investigated for its suitability as a reactor flux monitor and was found to have a much greater practical utility than most of the monitors reported. Three Al foils and one wire were randomly selected from four different commercial sources, and analyzed for their Fe, Ga, Mn and Na contents by neutron activation and high-resolution gamma-spectrometry. While Na was found to have a very heterogeneous distribution, Fe, Mn, and Ga concentrations in different splits of each type of Al were consistently uniform within ±2 to 3%. Eight possible monitor reactions on Al, Mn, Fe and Ga have been recommended as neutron flux integrators for all the 3 components of a reactor spectrum, viz. thermal, epithermal, and fast, covering a wide range of flux levels from 10^7 to 10^{14} $n \cdot cm^{-2} \cdot sec^{-1}$. The advantages and versatility of commercial grade Al as a pile neutron dosimeter are discussed. (auth)

10191 COMBINED SCINTILLATION DETECTOR IN AN OMNIDIRECTIONAL RADIATION FIELD. Petr, I. Jad. Energ.; 19: No. 7, 269-272(1973). (In Czech).

The analysis confirmed by the experiment clarifies the properties of a combined scintillation detector (consisting of two adjacent cylindrical scintillators viewed by one photomultiplier) in an omnidirectional radiation field of gamma rays. It is proved that a suitable choice of scintillator materials and dimensions renders a possible reduction in the combined scintillator sensitivity in the surrounding background field. (auth)

10192 DEVICE FOR STUDY OF HIGH ENERGY FISSIONS IN Au NUCLEI. Tamai, E. (Nihon Univ., Narashino); Roberts, J. H. Nihon Daigaku Seisan Kogakubu Hokobu; 5: No. 1, 193-199(Mar 1972). (In Japanese).

A study of high-energy fission phenomena induced by N^{+7} ion beams with energies of 250 MeV/nucleon and 1.0 and 2.05 BeV/nucleon in gold targets was undertaken. Stacks consisting of gold foils, Diacel films, and Lexan films in which etchable tracks are produced by fission fragments from Au nuclei are described. (auth)

10193 RADIATION CONTROL APPARATUS. Girle, H. D. (to Graetz KG). German Patent 1,954,529. 6 May 1971. Filed date 29 Oct 1969.

A radiation monitor that produces an audible signal that is practically proportional to the intensity of the radiation is described. (TFD)

10194 CALIBRATION OF AN ACCIDENT RADIATION PERSONNEL MONITOR IN MICROCURIE PER ORGANISM. Denisikov, A. I.; Meshkov, V. K.; Lazintseva, V. V.; Sobolev, Yu. P.; Sokolov, A. D.; Suchkova, L. A. pp 87-94 of Yadernoe priborostroenie. Moscow; Atomizdat (1972). (in Russian).

The results of the development of a method for the calibration of accident radiation personnel monitors by means of a collection of standard γ sources are reported. The different measurement geometries examined include an arc of 1 and 1.75 m and chair and stool configuration geometries. The results of the comparative measurements in the shielded chamber of the SUCH-2.2 device are reported. This accident radiation personnel monitor, constructed on the modular basis, makes possible with experimental methods the measurement of the activity in the body of patients. (tr-auth)

10195 SEPTAL PENETRATION IN SCINTILLATION CAMERA COLLIMATORS. Muehllehner, G.; Luig, H. (Nuclear Chicago Corp., Des Plaines, IL). Phys. Med. Biol.; 18: No. 6, 855-862(Nov 1973).

In order to be able to calculate the line spread function of camera collimators, taking into account differences in hole shape and septal penetration of computer program was written and is described which determines the line spread function by tracing a large number of rays through the collimator. First results are shown and further uses of the approach are described. (auth)

10196 SENSITIVE FAST NEUTRON MONITOR USING FISSION-FOIL LEXAN DETECTORS. Rago, P. F.; Barrall, R. C.; Carter, T. G. (Stanford Univ., CA). Health Phys.; 26: No. 1, 102-104 (Jan 1974).

A method of monitoring neutron fluence is described using thick ^{235}U fission-track registers developed for use as a neutron area monitor. The method allows integration of neutron dose equivalent for times up to at least 1 yr. The moderated fission foil-Lexan detector has been found to be a useful method of monitoring the neutron fluence and dose equivalent around the Stanford High Energy Physics Laboratory and Ryan Laboratory Research Reactor. The present yearly dose equivalent limit for an uncontrolled area is 500 mrem and thus a very sensitive method for detecting the accumulated dose equivalent is necessary and the reported method has been found most satisfactory. (UK)

10197 LIQUID SCINTILLATION COINCIDENCE DETECTOR. Laney, B. H. (to G. D. Searle and Co.). US Patent 3,772,512. 13 Nov 1973. Filed date 2 Jul 1971. 10p.

An improved liquid scintillation coincidence detector with means for determining the number of accidentally coincident electrical discharges, on a statistical basis, in the photodetectors is described. These accidentally coincident discharges largely result from the phosphorescent qualities of the samples measured in the liquid scintillation counter. When accidental coincidences exceed an upper limit, which is dependent upon the rate of occurrence of total coincidences, the coincidence counter is disabled. (Official Gazette)

10198 RADIATION DETECTION METHOD. Fleischer, R. L.; Walker, R. M. (to General Electric Co.). US Patent 3,770,962. 6 Nov 1973. Filed date 1 Nov 1971. 8p.

A method for detecting and measuring charged particles is described. A thin sheet of a dielectric material is exposed to form tracks which pass through the thickness of the sheet. The sheet is then contacted with an etchant which selectively dissolves and removes the tracks of radiation damaged material to form holes extending from one surface of the sheet through the opposite surface. The resulting holes are a measure of radiation damage and are detected by visual means by detecting the light which emerges from the holes on the one side of the etched sheet while the opposite side of the etched sheet is irradiated with light having a wavelength which is absorbed by the material in an amount sufficient to produce a significant contrast to the light passing through the holes. (Official Gazette)

10199 DISCUSSION OF COMPUTER CODES FOR DETERMINING NEUTRON FLUX SPECTRA BY MULTIPLE FOIL MEASUREMENTS. Annu. Book ASTM Stand.; 1581-1586(1973).

Three computer codes (SAND-II, SPECTRA, and RDMM) used to determine neutron flux spectra from a set of measured detector activities are described. The technique involves forming a set of simultaneous equations expressing activities of the detectors used as functions of differential flux, and obtaining a differential flux spectrum for which the calculated activities agree (within acceptable limits of error) with the measured activities. Spectral shape will be determined only to the extent that the response functions or cross sections of the various detectors used are linearly independent. In principle, any material that produces a detectable neutron reaction product may be used; the product need not be radioactive. Available codes are written, however, for radioactivation techniques. (auth)

10200 STANDARD METHOD FOR MEASURING NEUTRON FLUX BY RADIOACTIVATION TECHNIQUES. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 11p. (ASTM-E-261-70).

The method covers the determination of neutron flux in a radiation field from the radioactivity that is induced in a detector specimen. The description is directed toward the need for characterization of the magnitude and energy distribution of neutron flux in connection with radiation effects on materials. Since the effect of bombardment by neutrons depends upon the energy of the neutrons, it is important to establish techniques in which the energy distribution of the neutrons as well as the total flux is determined. Accordingly, different neutron-detecting materials are used that are sensitive to neutrons in various energy ranges. In this method, the considerations that apply rather generally to neutron activation detectors are discussed. (auth)

10201 STANDARD METHOD FOR MEASURING THERMAL NEUTRON FLUX BY RADIOACTIVATION TECHNIQUES. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-E-262-70).

The purpose of this method is to define a general procedure for measuring an unknown thermal neutron flux by neutron activation techniques. It is not practicable to describe completely a technique applicable to the large number of experimental situations that require the measurement of a thermal-neutron flux. Therefore, this method is presented so that the user may adapt to his particular situation the fundamental procedures of the following techniques: (1) technique using pure cobalt metal and cobalt-aluminum alloy (absolute counting of ^{60}Co is required); (2) standard foil technique using pure gold, and; (3) secondary standard foil techniques using pure indium, indium-aluminum alloy, and dysprosium-aluminum alloy. The techniques presented are limited to measurements at room temperatures. However, special problems when making thermal-neutron flux measurements in high-temperature environments are discussed. The useful neutron-flux ranges for each detector material are given. (auth)

10202 STANDARD METHOD FOR MEASURING FAST-NEUTRON FLUX BY RADIOACTIVATION OF IRON. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-E-263-70).

This method describes the measurement of fast-neutron fluxes with the threshold reaction, $^{54}Fe(n,p)^{54}Mn$. The reaction produces the radionuclide ^{54}Mn, having a half-life of 314 d, when irradiated in the fast-neutron fluxes present in nuclear reactors. ^{54}Mn emits gamma rays having an energy of 0.84 MeV which are easily detected with a gamma-ray spectrometer. A competing activity can result fromthe 1.3 and 1.1-MeV gamma rays of ^{59}Fe, formed in the reaction $^{58}Fe\ (n,\gamma)\ ^{59}Fe$. If the iron is exposed to thermal neutrons, a chemcial separation may be required to isolate ^{54}Mn. Pure iron is readily available and easily handled. With suitable techniques, fission neutron fluxes in the approximate range from 10^9 neutrons/cm^2/s to 10^{15} neutrons/cm^2/s can be measured. The $^{54}Fe(n,p)^{54}Mn$ threshold reaction, because of the relatively long half-life of ^{54}Mn, is capable of measuring fast neutron fluence over irradiation times approaching 1 y. (auth)

10203 STANDARD METHOD FOR MEASURING FAST-NEUTRON FLUX BY RADIOACTIVATION OF NICKEL. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-264-70).

This method describes a means of measuring fast-neutron flux with the threshold reaction $^{58}Ni(n,p)^{58}Co$. This reaction proceeds to form two ^{58}Co isomers with half-lives of 71.3 d and 9.2 h. Decay of the 9.2-h isomer from its metastable state to the ground state produces a final 71.3 d ^{58}Co. Loss of ^{58}Co and ^{58m}Co by thermal-neutron burnout will occur in environments having thermal fluxes of 3×10^{12} neutrons/cm^2/s and above. The effective threshold energy of nickel is near that of sulfur for a fission spectrum. With suitable techniques, fission-neutron flux in the approximate range from 10^9 neu-

tron/cm²/s to 10^{15} neutrons/cm²/s can be measured. The 71.3-d half-life of ^{58}Co offers the advantage of measuring fluence up to irradiation times of 100 ds and to a minimum value in the range of 10^{22} neutrons/cm²/s. (auth)

10204 STANDARD METHOD FOR MEASURING FAST-NEUTRON FLUX BY RADIOACTIVATION OF SULFUR. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-265-70).

This method describes a means of measuring fast-neutron flux by activation of a sulfur threshold detector. The reaction $^{32}S(n,p)^{32}P$ is predominant and results in a convenient beta emitter having a 14.3-d half-life. Sulfur is readily available in pure form and radioactive contamination from other elements is not a problem. There are a few competing short-lived activities from neutron interactions with its isotopes, but these can normally be eliminated by waiting 24 h before counting. With suitable techniques, fission-neutron flux in the approximate range from 10^2 to 10^{12} neutrons/cm²/s can be measured. The measurement of fast-neutron fluence with sulfur is limited by the half-life of ^{32}P to irradiation times no greater than about 20 d. (auth)

10205 STANDARD METHOD FOR MEASURING FAST-NEUTRON FLUX BY RADIOACTIVATION OF ALUMINUM. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-266-70).

This method describes the measurement of fast-neutron fluxes with the threshold reaction, $^{27}Al(n,\alpha)^{24}Na$. This reaction produces ^{24}Na having a half-life of 15.0 h when irradiated in the fast-neutron fluxes present in nuclear reactors. ^{24}Na emits gamma rays with energies of 1.369 and 2.754 MeV. Two competing activities, ^{28}Al and ^{27}Mg, are formed in the reactions $^{27}Al(n,\gamma)^{28}Al$ and $^{27}Al(n,p)^{27}Mg$, respectively. Pure aluminum is readily available and as a metal offers no handling problems. With suitable techniques, fission neutron fluxes in the approximate range from 10^7 to 10^{15} neutrons/cm²-s can be measured. The $^{27}Al(n,\alpha)^{24}Na$ threshold reaction is limited by the half-life of ^{24}Na to measuring fast-neutron fluence over irradiation times less than about 1 d. (auth)

10206 STANDARD METHOD OF TEST FOR FAST-NEUTRON FLUX BY ANALYSIS OF MOLYBDENUM-99 ACTIVITY FROM URANIUM-238 FISSION. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-E-343-72).

This method covers the measurement of fast-neutron fluxes by measuring the activity of the fission product ^{99}Mo produced by the threshold reaction $^{238}U(n,f)$. This reaction produces many fission products, among which is ^{99}Mo, having a half-life of 66.7 h. It emits gamma rays of several energies, which are easily detected and identified by a gamma-ray spectrometer. Competing activity from other fission products requires that a chemical separation be employed to isolate the ^{99}Mo. High-purity ^{238}U is available and easily handled. With suitable techniques, fission neutron fluxes can be measured in the range from 10^7 to approximately 10^{14} neutrons/cm²/s. The measurement of time-integrated fast-neutron flux with ^{238}U by ^{99}Mo analysis is limited by the half-life of ^{99}Mo to irradiation time no greater than about 100 h. (auth)

10207 TENTATIVE METHOD FOR FAST-NEUTRON FLUX MEASUREMENTS BY TRACK-ETCH TECHNIQUE. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-418-70-T).

This method covers the measurement of neutron flux by the use of fissionable materials. Fission fragments emitted by the fissionable materials during neutron bombardment penetrate a suitable recording medium, such as plastic, glass, or mica, that is in contact with the fissionable material. Appropriate etching techniques render the path of the fragment in the recording medium visible under an optical microscope. Since measurement of the decay of radioisotopes is not involved in this method, irradiation times are limited only by the maximum number of fission fragment tracks that can be clearly distinguished without pile up: approximately 2×10^5/cm². The number of tracks produced can be varied by changing the amount of available target nuclei or the length of the irradiation period, or both. (auth)

10208 TENTATIVE GUIDE FOR SELECTION OF NEUTRON ACTIVATION DETECTOR MATERIALS. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-419-70-T).

This guide covers selection of neutron-activation detector materials. The technique of neutron activation is the most widely used method for determination of neutron spectra, flux, fluence, and related measurements. In order to optimize the usefulness of this technique, it is highly desirable to be able to compare the measurements made by different investigators. The major variations in results are due to counting techniques, cross-section values, fission yields, and the neutron-activation detector materials. In order to minimize these variations, this guide for standardizing the neutron activation detector materials in current use is presented. (auth)

10209 STANDARDS IN MEASURING NEUTRON RADIATION CHARACTERISTICS. Shchebolev, V. T.; Kharitonov, I. A. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 5, 742-745(May 1973).

Translated from Izmer. Tekh.; 16: No. 5, 69-70(May 1973).

State standards for measuring unit densities of thermal neutron fluxes and total fast neutron fluxes at the D. I. Mendeleev All-Union Scientific-Research Institute of Metrology are discussed. The use of gold-197 activation detectors for thermal neutron fluxes and the method of accompanying particles and the manganese activation method for fast neutron fluxes are discussed. It is suggested that a moderator with the thermal neutron flux standard be used for measuring fast neutron flux. (WHK)

10210 OPTIMUM RELATIONSHIPS FOR CALCULATING THE ERROR OF RADIOISOTOPIC INSTRUMENTS. Klempner, K. S. Cherednichenko, I. M. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 5, 746-750(May 1973).

Translated from Izmer. Tekh.; 16: No. 5, 71-73(May 1973).

The conditions for the minimum error in measuring quantities relating to nuclear radiation fluxes are examined, taking into account all types of errors in the measuring circuit. Theoretical expressions relating the optimum measuring conditions are given. (WHK)

10211 SCINTILLATION ANALYSIS SYSTEM. Peterson, J. I. (to Dept. of Health, Education and Welfare). US Patent 3,776,695. 4 Dec 1973. Filed date 30 Sep 1970. 18p.

A system for the combustion preparation of samples for scintillation analysis comprising a combustion tube containing a combustion catalyst, a chimney tube positioned within the combustion tube and resting on the catalyst and means for admitting a sample for combustion, oxygen gas for ignition, and an outlet means for the combustion product is described. Also, means for collecting the combustion products comprising: for H_2O an externally cooled condenser-like system containing means for contacting a scintillation solvent with the gaseous combustion products in a cooled zone; and for CO_2 an externally cooled condenser-like system containing a helical rotatable band within the inner bore thereof for distributing a scintillation solvent along the walls thereof for countercurrent contact with the CO_2 combustion product are described. (22 claims, 3 drawing figures) (Official Gazette)

10212 CALIBRATION OF A CYLINDRICAL IONIZATION CHAMBER USED FOR ^{85}Kr MONITORING. Iwata, Y.; Kishida, M.; Oshino, J. (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 8: No. 3, 161-165(Sep 1973). (In Japanese).

An experimental method for calibrating a chamber used for ^{85}Kr monitoring is described. Experiments were made with a cylindrical ionization chamber, 114 mm in diameter, 150 mm in height with walls of stainless steel, by using ^{85}Kr gaseous sources. In order to standardize a ^{85}Kr gaseous source used for the experiments, the activity of ^{85}Kr in the gas was determined by the method of mass spectrometry. The standardized gas was diluted with air to obtain the suitable concentration of ^{85}Kr for the calibration. In the calibration, the relation between activities of ^{85}Kr in the chamber and saturated ionization currents was studied with the gases of various concentrations of ^{85}Kr. The calibration factor of the chamber was found to be 5.42×10^{-9} A/(μCi/cm³). (auth)

10213 NEW STACK MONITOR CONCEPT AND ITS DESIGN. Moriuchi, S.; Miyanaga, I. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 7, 509-515(Jul 1973). (In Japanese).

External exposure due to radioactive inert gases from a stack presents important problems to the environment near nuclear power stations, and the monitoring of these gaseous effluents has been undertaken by measuring the gross radioactivities of gaseous effluents in Ci/sec, using a stack monitor. For evaluating the external exposure from a gaseous mixture of Kr and Xe isotopes in the environment, the usual methods are not satisfactory and are even meaningless when the fractions of radionuclides in the mixture gas change according to the storage or hold-up time. A new concept of stack monitor to measure the photon energy dissipating rate, the photon dissipating rate, and the average energy is discussed. It is shown that this method simplifies the evaluating procedures and improves the accuracy of γ-exposure evaluation. Fur-

ther, the design of a new stack monitor is presented, which consists of a NaI(Tl) scintillation head with a specially designed Pb shield cap and an electronic circuit for pulse height weighing. (auth)

10214 SILICON CARBIDE DETECTORS AS FISSION-FRAGMENT COUNTERS IN REACTORS. Tikhomirova, V. A.; Fedoseeva, O. P.; Bol'shakov, V. V. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 6, 900-901 (Jun 1973).

Translated from Izmer. Tekh.; 16: No. 6, 67-68 (Jun 1973).

Results of an investigation of the changes in the basic characteristics of SiC detectors during their actual use are given. The basic characteristics considered were: counting rate, reverse current, capacity, signal amplitude produced by α particles, and noise levels which is defined as the width of the noise strip observed on an oscilloscope screen. The magnitude of the strip is the base of a Gauss curve. (TFD)

Radiation Dosimeters

10215 (AAEC/E-283) EXPOSURE CALIBRATION OF A THIMBLE CHAMBER BY CALORIMETRIC AND IONIMETRIC METHODS. Urquhart, D. F.; Johnson, E. P.; Badger, W. S. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

A Baldwin-Farmer thimble chamber, fitted with a perspex build-up cap was calibrated against an absolute graphite cavity chamber to provide an interim working standard of exposure for ^{137}Cs and ^{60}Co photons. The calibration factor (roentgens per coulomb) at ^{60}Co energy was 2% higher than an NPL, 2 MV calibration for this chamber, carried out in the UK by the National Physical Laboratory. The thimble chamber, fitted with an aluminium build-up cap, was also used to make a comparison between the graphite cavity chamber and an aluminium micro-calorimeter which is to be used as an interim absorbed dose standard. Exposure calibration factors for the thimble chamber derived from calorimeter measurements were in good agreement with calibration factors derived from cavity chamber measurements, at both ^{137}Cs and ^{60}Co energies. (auth)

10216 (INIS-mf-922) COMPARATIVE STUDY OF PHOTOGRAPHIC, THERMOLUMINESCENT, AND RADIOPHOTOLUMINESCENT DOSIMETERS. Deus, S. F. (Sao Paulo Univ. (Brazil). Escola Politechnica). 1971. 84p. (In Portuguese). INIS.

Thesis.

Comparison was made between the responses of three different dosimetric systems, namely, photographic, thermoluminescent (TL), and radiophotoluminescent (RPL). The comparison was divided in two parts. The first was carried out in known radiation conditions (exposure, normal incidence, energy) and under controlled environment (~27°C temperature, ~70% relative humidity). Under these conditions, the response as a function of exposure and energy, the relation of the linearity to the energy, the lowest detectable exposure, and the reproducibility, were studied. The response against exposure at 37 KeV and at 1 MeV was found to be linear in the region of interest to routine personnel dosimetry for all dosimeters except for the films. (INIS)

10217 (ORNL-4903, pp 1-18) DOSIMETRY FOR HUMAN EXPOSURES AND RADIOLOGICAL IMPACT. Kerr, G. D.; Jones, T. D.; Cheka, J. S.; Dickson, H. W.; Fox, W. F.; Lupica, S. B.; Willhoit, D. G.; Shonka, J. J.; Chu, S. L. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Topics include the Japanese dosimetry program, in utero exposure of A-bomb survivors, thermal neutron fluence distributions, dose and fluence in isotropic and nonuniform fields of radiation, ICRU neutron dosimetry intercomparison, and improvements in nitrocellulose film. (WHK)

10218 (ORNL-4903, pp 19-30) SOLID-STATE DOSIMETRY RESEARCH. Becker, K.; Abd El-Razek, M.; Cheka, J. S.; Crase, K. W.; Haywood, F. F.; Nagpal, J. S.; Tham, T. D.; Gammage, R. B. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Thermally stimulated exoelectron emission (TSEE) reader development, TSEE detector sensitivity and reproducibility, gas effects on TSEE, TSEE in personnel and environmental monitoring, fast neutron dosimetry by TSEE, TSEE monitoring of beta emitters, TLD and film stability studies, TL detector development, and information and education activities are discussed. (WHK)

10219 (ORNL-4903, pp 45-50) SPECTROMETRIC DOSIMETRY. Thorngate, J. H.; Christian, D. J.; Perdue, P. T.; Shinpaugh, W. H.; Abd El-Razek, M. M. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Topics include organic scintillator research, distribution of charged-particle stopping, HPRR neutron and gamma-ray spectrum incident on the roof of the DOSAR, alpha air monitor electronics, and a convenient counter for measuring the alpha activity of air samples. (WHK)

10220 (ORP/EERF-73-1) SUITABILITY OF GLASS-ENCAPSULATED CaF_2:Mn THERMOLUMINESCENT DOSIMETERS FOR ENVIRONMENTAL RADIATION SURVEILLANCE. Partridge, J. E.; Windham, S. T.; Lobdell, J. L.; Oppold, J. A. (Environmental Protection Agency, Washington, D. C. (USA)). Jun 1973. 21p.

The suitability of glass-encapsulated CaF_2:Mn thermoluminescent dosimeters for environmental radiation surveillance was investigated. More than two hundred dosimeters were subjected to extensive laboratory and field tests. Various parameters such as accuracy, precision, sensitivity, self dosing, and fading were investigated. Selected dosimeters of this type can be used for accurate determination of environmental radiation levels if certain precautions are taken. Such precautions are proper calibration and determination of self-dosing characteristics for individual dosimeters. (auth)

10221 (ORP/EERF-73-3) PORTABLE ANNEALER FOR THERMOLUMINESCENT DOSIMETERS. Windham, S. T.; Kelley, H. L.; Plant, T. K. (Eastern Environmental Radiation Facility, Montgomery, Ala. (USA)). Jun 1973. 13p.

The annealer described has been in use for several months with good results and no malfunctions. Components used in construction of this compact annealer are readily available and construction requires no special skills or equipment. The cost of building the annealer, less than $75 including the optional timer, represents a significant savings compared to the repair cost and down time should damage to the TLD reader occur during shipment to monitoring sites. Use of the annealer makes unnecessary a number of these shipments. The effectiveness of the annealer in dedosing the TL-15 dosimeter was demonstrated. For exposures less than 200 mR, annealing was 100%. Thus the annealer has proven to be most adequate for environmental measurement work. (auth)

10222 (PTB-FMRB-48) USE OF EXOELECTRONS IN THE DOSIMETRY OF GAMMA AND X RADIATION. Kriks, H. J. (Physikalisch-Technische Bundesanstalt, Brunswick (F.R. Germany). Forschungs- und Messreaktor). Jul 1973. 81p. (In German). Dep. NTIS (U.S. Sales Only) $6.25.

Thesis. Submitted to Technische Univ., Berlin.

The thermally stimulated exoelectron emission (TSEE) of BeO powder deposited on graphite backings was investigated with regard to its suitability for the dosimetry of ionizing radiation. The results show that the requirements for the use in routine dosimetry are sufficiently fulfilled, i.e., the exoelectron yield is proportional to the exposure in the range from 1 mR (0.258 μC/kg) up to approximately 2 kR (0.516 C/kg), and the energy dependence of the exoelectron yield as related to the exposure is in good agreement to the calculated dependence of the mass energy transfer coefficients of the surrounding material as compared to those of air, a loss of the stored absorbed dose information first occurs above 60°C and is observed to be 10% at 90°C within a month. Additional investigations about the isothermal fading behaviour of the trapped electrons led to a method for the determination of the activation energy and for the corresponding frequency factor based on the kinetic model for the discharge of occupied traps. The estimated standard deviation for the exoelectron response of an individual dosimeter amounts to ±7% and is sufficiently low for routine measurements in personnel dosimetry. (auth)

10223 (RD/B/N-2645) INTERPRETATION OF SOME UNUSUAL FILM BADGE PATTERNS IN THE MEASUREMENT OF SURFACE DOSE. Hill, M. J.; Brindle, G. J. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

A film may occasionally have a non-standard density pattern for its filtered areas, in as much as the open window area is less dense than the plastic filtered areas. If measured by the existing standard dosimetry methods involving simplifying assumptions, an over-estimate of surface dose could result. The mechanism of how such patterns can occur is investigated and a suggestion is made to obtain a more accurate dose measurement. (auth)

10224 (SSI-1973-19) COMPARISON OF PULSE HEIGHT ANALYSIS AND VARIANCE MEASUREMENT FOR THE DETERMINATION OF DOSE MEAN SPECIFIC ENERGY. Bengtsson, L. G.; Lindborg, L. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Sep 1973. 20p. (CONF-730968-2). Dep. NTIS (U. S. Sales Only) $3.00.

From fourth international symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

The dose mean specific energy is a quantity in microdosimetry which has been suggested as an important parameter in radiobiology. It can be determined not only by pulse height studies on the microscopic distributions of energy deposited by single events (particle tracks), but also by measurements of the variance of the multiple-event distributions, that is, the spectra of signals from a suitable detector repeatedly subjected to a constant irradiation. Some related problems in pulse height and variance measurements are discussed such as the importance of pulse pile-up and energy per primary event (W). It is shown that in some cases with pulsed accelerator radiation the variance method holds promise to reduce the measurement time significantly, from hours to minutes. Results from variance and pulse height measurements with ^{60}Co gamma rays agreed within experimental errors of about 20 percent. At the smallest dimensions of the simulated spherical volumes, from 0.01 to 0.5 $\mu g/mm^2$, only variance results could be obtained at present. These imply that even at 0.01 $\mu g/mm^2$ (10 nm at density 1 g/cm^3) the significant contributions to the dose mean specific energy arise from multiple ionizations. (auth)

10225 CALORIMETRIC DOSIMETRY USING HIGH INTENSITY PULSED RADIATION. Melende, A.; Sutton, J. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 5-11(May 1973). (In French).

A calorimetric method is described for the absolute determination of the ionizing radiation dose absorbed by a liquid sample exposed to a fast intense (of the order of 10^{23} $eV \cdot g^{-1}s^{-1}$) and energetic electron pulse (2 MeV). The calorimeter was designed in order to study the effect of the thickness of the electron entry window and the thickness of the liquid layer on the absorbed dose. The yields of certain decomposition products of aqueous oxalic acid solutions were determined from the calorimetric results. These solutions are frequently employed for chemical dosimetry. (FR)

10226 G-VALUE FOR THE FERROUS SULPHATE DOSEMETER FOR RADIATION FROM CALIFORNIUM-252. Greene, D.; Law, J.; Major, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Phys. Med. Biol.; 18: No. 6, 800-807(Nov 1973).

The $FeSO_4$ G-value for the mixed neutron and γ-radiation from californium-252 has been measured experimentally using ionization dosimetry. A value of 9.9 ± 0.7 was obtained for irradiations in air (γ-component 31%) and 10.1 ± 0.8 in water, a scattering medium, (γ-component 43%). Calculated G-values for the neutron component alone were consistent with theoretical predictions. (auth)

10227 RADIOACTIVITY ORIGINATES FROM $CaSO_4$:Dy AND $CaSO_4$:Tm, PHOSPHOR POWDERS. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Huang, C. Y. Health Phys.; 26: No. 1, 104(Jan 1974).

Two types of thermoluminescent dosemeters, $CaSO_4$:Dy and $CaSO_4$:Tm have been used in environmental monitoring for all nuclear establishments in northern Taiwan since 1970. The laboratory procedures used to produce the calcium sulphate phosphors are outlined. The radioactivity originating from the powders were found to be 1.24 ± 0.10 and 1.66 ± 0.08 mR/30 days for $CaSO_4$:Dy and $CaSO_4$:Tm respectively. (UK)

10228 MICROCALORIMETRIC MEASUREMENTS OF THE ACTIVITY OF TRITIATED WATER SAMPLES. Dalmazzone, J.; Dhilly, G. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 19-24(May 1973). (In French)

Microcalorimetry enables self-absorption errors (sometimes quite large) to be eliminated from measurements of the α and β activities of nuclides. Modifications and improvements to the method permitted calibrations to be made with tritiated water samples. The largest uncertainty factor in determining the activity of the HTO solution arises from the incorrect value of the mean β energy. Proposals are suggested for its improvement. In this way, an accuracy of the order of 1% can be achieved. The method will then yield results which are competitive to those obtained by other techniques, e.g., gas counting. (FR)

10229 ENERGY DEPENDENCE OF LITHIUM FLUORIDE DOSEMETER FOR HIGH ENERGY ELECTRONS. Antoku, S.; Sunayashiki, T.; Takeoka, S.; Takeshita, K. (Univ., Hiroshima). Phys. Med. Biol.; 18: No. 6, 889-891(Nov 1973).

A lithium fluoride and a Fricke dosemeter have been exposed simultaneously to ^{60}Co γ-rays and 10, 20, and 30 MeV electrons to study the energy dependence of the lithium fluoride dosemeter for high-energy electrons, with particular reference to possible significant reductions in the sensitivity of LiF phosphors for electrons as compared with ^{60}Co γ-rays. In the present study, the direct comparison excluded errors resulting from uncertainties about ion recombination and conversion factors from roentgens to rads for ionization chambers. The dosemeters were exposed to approximately 5000 rads of each radiation at the appropriate peak depth in a water phantom. Corrections for the supra-linear response for LiF were made using a dose response curve for ^{60}Co γ-rays. The three types of LiF phosphor examined did not exhibit any energy dependence for electrons compared with ^{60}Co γ-rays within the statistical uncertainty (~3%) for the experiment. (UK)

10230 DOSIMETRY OF IONIZING RADIATION BY COLORED GLASS DETECTORS. Tkachenko, V. V.; Briskman, B. A.; Kovalenko, L. M.; Lavrentovich, Ya. I.; Orlov, N. F. At. Energ. (USSR); 35: No. 3, 210-211(Sep 1973). (In Russian).

Tests of Mn-activated colored alumo-phosphate glasses with a ^{60}Co source and in the experimental channels of a WWR reactor indicated that these glasses can be used for measuring not only the gamma radiation dose from an isotopic gamma source but also the accelerated charged particles and the gamma dose in a mixed neutron-gamma field. (MWG)

10231 CALORIMETRIC MEASUREMENTS WITH TRITIATED COMPOUNDS. Sanson, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 13-18(May 1973). (In French).

The apparatus is presented together with its calibration. The calibrations made for tritium and plutonium are compared with those obtained during the Joule effect. (FR)

10232 VACUUM RADIATION ELEMENTS FOR MEASUREMENTS OF INTENSIVE GAMMA RADIATION DOSES. Mukhachev, B. V.; Pushkarev, A. V.; Samoilov, P. S. pp 63-71 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

The construction, calibration, and test results of vacuum radiation γ elements for measurement of the output of the exposed dose of high-intensity γ radiation are described. The elements do not require an external feed. The diameter of the sensitive portion of the elements is 6 mm with a length of 150 mm. It was shown that the sensitivity of the elements is higher the difference of the atomic numbers of the material of the emitter and collector (stainless steel). The sensitivity of the elements with Zr and Ta emitters is 1.5×10^{-13} and 6×10^{-13} a/(r/sec) respectively. The results of the testing of the elements in the SM-2 reactor are reported. It was shown that the elements are efficient in the range from 10^3 to 10^6 r/sec at temperatures up to 500°C. The output signals of the elements are proportional to the reactor power and do not depend on the temperature. The magnitude of the resistance of the insulation of the elements under actual operational conditions is no higher than 10^7 ohm. (tr-auth)

10233 RADIATION DOSIMETRY WITH THE MODIFIED CHLORAL HYDRATE SYSTEM. Moos, W. S. (International Atomic Energy Agency, Vienna); Lanzl, L. H.; Brunner, H. Int. J. Appl. Radiat. Isotop.; 24: No. 11, 645-648(Nov 1973).

A study of the radiation energy and dose rate dependence of the chloral hydrate dosimeter system is reported. The magnitude of batch-to-batch variations to be expected in the preparation of the solutions and the effects of container size are considered. It is concluded that due to the linear response over large dose ranges exhibited this system should definitely have a place in dosimetry, especially in the lower dose ranges where the Fricke and similar chemical dosimeters require special procedures. Chloral hydrate would not replace the Fricke dosimeter as the accepted standard method for absorbed dose measurements, but it would serve as a supplement on the basis of its simplicity, long storage life, low manpower costs and, in particular, the fact that it does not require the high doses necessary for obtaining reliably Fricke readings.(UK)

10234 RECORDING OF IONIZING RADIATION BY A DIELECTRIC LIQUID LOCATED IN THE ELECTRIC FIELD. Suslov, A. P.; Zavgorodnii, V. C.; Patrushev, G. N. At. Energ. (USSR); 35: No. 2, 129-130(Aug 1973). (In Russian).

The height of a liquid dielectric column changed with the absorbed dose, the difference between the theoretical and experimental Δh being only 0.83 mm. The relative error was ±40% due to the short height of the liquid column in the lower part of the curve. An empirical formula is given which shows the change, within ±15%, in the time constant of the capacitor with change in the absorbed dose. The possibility of using such a liquid column for measuring the absorbed dose is considered. (auth)

10235 CALCULATED RESPONSE OF ^{6}LiF ALBEDO DOSIMETERS TO NEUTRONS WITH ENERGIES ≤400 MeV. Alsmiller, R. G. Jr.; Barish, J. (Oak Ridge National Lab., TN). Health Phys.; 26: No. 1, 13-28(Jan 1974).

The calculated response of several albedo-neutron dosimeters that use ^{6}LiF as the neutron sensing element is presented for neutron energies ≤400 MeV. For each of the dosimeter geometries considered, results are presented for both monoenergetic and continuous incident neutron spectra and for both normally and

isotropically incident neutron fluences. Data are given to indicate the effect on the response of an air gap between the dosimeter and the tissue phantom. (auth)

10236 MAIN ERROR COMPONENTS OF A RADIOTHERMOLUMINESCENCE DOSIMETER. Sokolov, A. D. pp 78-86 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

On the basis of an analysis of the literature data, an evaluation was made of the magnitudes of three components of the relative values of the principal errors of a radiothermoluminescent dosimeter: errors of the master source (instrument), errors of the dose transfer, and random errors of the dosimeter. Examination of the components as independent random magnitudes showed that in dependence on the assumed confidence interval for the basic errors and its component magnitudes the errors vary in the interval from 10 to 30%. The average quadratic deviation of the dosimeter reading during measurement of any dose value with different detectors of the same kind was determined. (tr-auth)

10237 NEUTRON DOSIMETRY WITH VARIOUS SOLID STATE FISSION TRACK DETECTORS. Tsuruta, T. (Kyoto Univ., Kumatori, Japan). Nippon Genshiryoku Gakkaishi; 67: No. 3, 462-472 (Sep 1973).

The properties of three types of solid state fission track detectors for neutron dosimetry have been studied. The detectors were irradiated with monochromatic fast neutrons and a count was made of the number of etch-pits on the surfaces of the irradiated detectors after etching with suitable chemical reagents. The first type of detector examined was glass or mica, which was in contact with a thin film of thorium or uranium. The experiment proved that the sensitivity is in proportion to the amount of fissionable material per unit area. The second type was glass, mica or plastics, which was in contact with a thick foil of the fissionable material. It was shown that the measured sensitivity could be explained in terms of the range of the fission fragment in the fissionable material. The third type was metaphosphate glass, which was doped with thorium and/or uranium. It was found that the dependence of the sensitivity on etching time could be explained from the thickness of the layer removed from the glass surface by the etching. A discussion is given of neutron dosimetry having a wide range of energy in mixed radiation fields with these detectors. (auth)

10238 DOSIMETRIC DEVICE FOR MEDICALLY USED PARTICLE ACCELERATORS. Frankenberg, D.; Heigner, G.; Pohlit, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main). Strahlentherapie; 146: No. 2, 208-215 (1973). (In German).

A new type of dosimeter is described which fulfills every task of radiation measurement on medically used accelerators. It works with 2 paths (measuring and control path) independent one from the other which disconnect the accelerator, as soon as the wanted dose is reached or in case of a disturbance in the dosimeter itself or in the accelerator. The homogeneity of the beam bundle used is checked continuously. The apparatus can be used for calibration of the measuring counter and for control of the particle energy. In this way it replaces a number of other necessary auxiliary equipment. (GE)

10239 SEMI-AUTOMATIC DEVICE FOR DOSIMETRIC MEASUREMENTS IN A PHANTOM. Bytina, K. (Ustav Fyziky Plazmatu, Prague). Cesk. Radiol.; 27: No. 2, 125-128(Mar 1973). (In Czech).

A device for measuring isodose curves in a water phantom is briefly described. The measurement of the course of ionization in various planes of the water phantom was used for constructing isodoses. The ionization chamber signal was recorded using a planar coordinate recorder. The position of its recording stylus was determined by two coordinates X-Y of which one was proportional to the chamber position in one of the three coordinates of the water phantom while the other was proportional to the ionization chamber signal. (INIS)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 10871 and 11483.

10240 (CEA-CONF-2322) NEW MECHANICAL SPECTROMETER USING THERMAL NEUTRONS. Bugnone, C.; Comera, J. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct 1971. 22p. (In French). (CONF-720228-1). Dep. NTIS (U. S. Sales Only) $3.25.

From meeting of the Euratom working group on dosimetry; Hamburg, F. R. Germany (24 Feb 1972).

A new continuous chopper consisting of a mechanical monochromator whose outlet windows are replaced by a neutron detecting surface is described. All the corrections necessary to correlate the signal obtained on the detector disc to the energy spectrum of the incident neutrons are given. The first tests with the chopper show that the analysis obtained is good but the reading of the films can be improved. The chopper is easy to mount and can be used for the study of the modifications of thermal spectra with the aid of filters and for the study of the effects of hot and cold sources. (JSR)

10241 (COO-3258-1) ENERGETIC NEUTRON SPECTROMETRY. Final Report, December 1, 1967–March 31, 1972. Madey, R.; Waterman, F. M. (Clarkson Coll. of Tech., Potsdam, N. Y. (USA)). Nov 1973. Contract AT(30-1)-3914. 95p. Dep. NTIS $6.75.

A research program in energetic-neutron spectrometry was carried out under Contracts AT(30-1)-3914 and AT(11-1)-3258 with Clarkson College of Technology during the period from 1 December 1967 through 31 March 1972. Accomplishments under this program include the development of a self-contained time-of-flight spectrometer for neutrons from 1 to 500 MeV and the measurement of neutron spectra from a thick target. Basically, the spectrometer measures the time-of-flight of a neutron scattered between two scintillation counters. The intrinsic time dispersion of the system is 2.2 nanoseconds (fwhm) with a $2\frac{1}{2}$ inch diameter by $2\frac{1}{2}$ inch high first detector and a 9 inch diameter by 8 inch thick second detector. For a flight path of 4 meters, the energy resolution of the spectrometer varies from about 2×10^{-9} at 10 MeV to 8×10^{-7} at 500 MeV. Background from neutron–carbon interactions is determined from separate spectral measurements with first detectors differing significantly in their relative hydrogen–carbon composition. Measurements with 14 MeV neutrons confirm the resolution and efficiency of the spectrometer at low energies. Measurements at 220 MeV verify the resolution of the spectrometer at this energy and demonstrate the technique for subtracting the carbon background. Neutron spectra from 740 MeV proton bombardment of a 30-cm thick uranium target were measured from 20 to 500 MeV at 50 degrees and from 5 to 140 MeV at 130 degrees with respect to the proton beam at LBL. The results are compared with a Monte Carlo calculation of the neutron cascade-evaporation spectrum. While the shapes of the measured and calculated spectra are in general agreement, this comparison shows that the intranuclear cascade model underestimates the production of cascade neutrons at wide angles; furthermore, this comparison shows that this discrepancy increases with increasing angle of emission. (auth)

10242 (FEI-362) SPECIAL METHODS OF PROCESSING AND REGISTRATION OF APPARATUS DISTRIBUTIONS OF NEUTRONS AND GAMMA-QUANTA. Trykov, O. A.; Vladimirov, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

A new method is described for processing and recording the neutron and gamma amplitude distributions in gamma spectra. Scintillation counters with organic phosphors and gas-discharge proportional counters operating by proton recoil are used with self-readout apparatus. The proposed method increases the suppression of the gamma background in the neutron spectrometer by a factor of 10 or more at energies below 300 to 500 keV with the scintillation counters and below 10 to 20 keV with proportional counters containing hydrogen. The decrease in gamma background and resulting decrease in energy threshold is due to the total decrease in gamma quanta. A mathematical development of the subject is presented. (TTT)

10243 (INP-836) AUTOMATIC UNIT FOR KD SOG-1 NEUTRON SPECTROMETER CONTROL. Bajorek, A.; Brankowski, J.; Olejarczyk, W.; Ostrowicz, A.; Sokolowski, J.; Starzewski, J.; Sciesinski, J.; Zaleski, T. (Institute of Nuclear Physics, Krakow (Poland)). May 1973. 54p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.75.

Control devices for the KD SOG-1 neutron spectrometer at the IBR-30 reactor are described with special regard to the unit controlling its kinematics. The logical structure and the cooperation of the individual blocks, as well as the possible variants of operation of the whole unit are presented. (auth)

10244 (ITEF-6) DISTORTION AND PARAFIT PROGRAMS FOR MORE PRECISE DEFINITION OF GEOMETRIC AND OPTICAL CONSTANTS OF LIQUID HYDROGEN CHAMBERS. Arutyunyants, G. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 14p. (In Russian). INIS.

Programs were proposed for making more precise the geometric and optical constants of a sterophoto device consisting of three photochambers. The possibility of fitting 40 different parameters (no more than 15 simultaneously), affecting the quality of the

geometric recovery of the point in three dimensions, is provided for. (tr-auth)

10245 (ITEF-7) ERRORS OF PARTICLE MASS MEASUREMENT IN BUBBLE CHAMBERS. Arutyunyants, G. A.; Pletnikov, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 7p. (In Russian). INIS.

The effect of statistical measurement errors on the position and width of peaks in the mass spectrum studied in the bubble chamber was examined. The systematic character of the negative shift of the deficient masses in the 4c-fit reactions was shown. Formulas were derived for the width and position of the peaks. These formulas give satisfactory agreement with experimental data. (tr-auth)

10246 (JINR-P3-7379) SYSTEM FOR CREATION OF OSCILLATING MAGNETIC FIELD IN MAGNETIC RESONANCE SPECTROMETER ON UCN. Nikitenko, Yu. V.; Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 16p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

To obtain a sensitivity of 10^{25} to 10^{-27} cm, when measuring the EDM of a neutron, the requirements were determined for the system for creating an oscillating magnetic field in a magnetic resonance storage spectrometer using polarized ultracold neutrons. Calculations are presented for two systems that consist of rectangular coils (curved on a cylindrical surface) and thin metallic plates. The latter system is preferred as one providing the best homogeneity of the field in the storage system of the spectrometer. The topography of the field is measured using the model of this system that has $1/4$ the necessary dimensions, and the obtained results are compared with calculations. (auth)

10247 (LNF-73-8) OPTICS OF THE MAGNETIC SPECTROMETER IN THE FIRST AND SECOND ORDER APPROXIMATIONS. Part II. Multipole Series Development of the Components of the Field at the Interior of the Central Trajectory. Sanna, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 1 Mar 1973. 57p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.00.

The properties and general equations valid for the stationary and solenoidal distributions of the field are summarized. The basic symmetry of the magnetic scalar potential is introduced and characterized analytically. A classification is then made of the distributions in the optics. These distributions are individualized. Particular distributions commonly denoted as pure or ideal are analyzed. Optical functions associated with multipole terms are derived. The possibility of obtaining integrated multipole terms of various orders using uniform fields is shown. (JSR)

10248 (NP-19893) NEUTRON BEAM FACILITIES AVAILABLE FOR UNIVERSITY USERS AT ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, AND ATOMIC WEAPONS RESEARCH ESTABLISHMENT, ALDERMASTON. (Science Research Council, London (UK)). Jun 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

The Science Research Council has arranged Agreements with AERE (Harwell) and with AWRE (Aldermaston) for the provision of neutron beam facilities for UK scientists in academic institutions. These are made available for use under the auspices of the Neutron Beam Research Committee of the Science Board of the SRC. Information is presented about these facilities. The main characteristics of each beam instrument are given but, because of the continuing development of techniques and of possible special requirements, a potential user should seek the latest information about any particular instrument from the University Support Section at the appropriate establishment. In the case of the AWRE the Agreement also includes ambient and 80K irradiation facilities and details of these are also given. Facilities include single crystal and powder diffractometers; time-of-flight, triple axis, and polarized neutron spectrometers; elastic defect scattering instruments; a liquids spectrometer; a total scattering spectrometer; and ancillary equipment. (WHK)

10249 TIME OF FLIGHT ELECTRON VELOCITY SPECTROMETER. Whitten, G. C. Orono, ME; Univ. of Maine (1973). 151p. University Microfilms Order No. 73-19,579.

Thesis (Ph.D.).

A time of flight electron velocity spectrometer has been developed for electrons of energy less than 100 eV. It has a resolution in energy comparable to that of other types of high resolution electron spectrometers, but is not subject to the limitations imposed on them by contact potential problems. The system in principle is similar to that of previously developed electron drift velocity spectrometers, but is capable of measuring electron velocities more than ten thousand times greater. The high resolution and extended velocity range are made possible by a system of very fast shutters operated by an especially designed power pulse circuit. A 40 volt pulse generator supplies simultaneous positive and negative pulses of less than 10 nanoseconds transition time to the electrical shutters. The pulse generator operates reliably at pulse repetition frequencies of up to 10 khz. The spectrometer is used to examine the velocity distribution of electrons from a 50 eV electron gun. The resolution of the spectrometer as determined from the experimental data is $\Delta E/E = 4\ E \times 10^{-3}$ (E in electron volts). The precision with which energy peaks can be located, however, is $\Delta E/E = 1.18\ E \times 10^{-6}$ (E in electron volts). (Diss. Abstr. Int., B)

10250 APPARATUS FOR SPECTRAL ANALYSIS AND COUNTING OF PULSES GENERATED FROM RADIOACTIVE DISINTEGRATIONS IN A RADIATION DETECTOR. Soini, E. J. (to Wallac OY). US Patent 3,772,515. 13 Nov 1973. Priority date 16 Apr 1971, Sweden. 4p.

An apparatus for spectral analysis and counting of electrical pulses in an instrument for measuring radioactive disintegrations such as liquid scintillation counters is described. The apparatus comprises a number of discriminators having preselected amplitude transmission ranges and optical indication means for indicating the spectral energy distribution of the pulses. Scalers are provided for counting the pulses within a number of these preselected amplitude ranges. (3 Claims, 3 Drawing Figures) (Official Gazette)

10251 SEMICONDUCTOR DETECTORS FOR GAMMA RAY SPECTROSCOPY OF SHIELDED SOURCES. Spiers, E. W.; Lakey, J. R. A. (Royal Naval Coll., Greenwich, Eng.). J. Inst. Nucl. Eng.; 14: No. 5, 138-142(Sep 1973).

Ge(Li) and Si(Li) detectors were evaluated for use in the measurement of the type of gamma spectra produced by a shielded source. Two main areas of application are examined—general reactor shield surveys, and the in situ analysis of inaccessible active material. It was found that in regard to response function, temperature stability, and compactness the Si(Li) detector has a significant advantage over the familiar NaI detector for application in portable shield survey spectrometers. Its major disadvantage is its low detection efficiency, due to an intrinsically low gamma ray interaction cross section and the lack of large volume detectors. The Ge(Li) detector was found unsuitable for shield surveys, but could be used to identify the spectrum of individual isotopes and resolve uncollided flux from scattered background. It is therefore well suited to the analysis of shielded radioactive substances with the aid of a simple computer program to correct the efficiency calibration to the geometry of the source. (UK)

10252 EVALUATION OF SENSITIVITY AND THE BACKGROUND COMPONENTS OF SCINTILLATION COUNTERS USED IN SPACE. Polenov, B. V.; Temnyi, V. V. pp 39-48 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

A description is given of the mechanism of the formation of background pulses in scintillation detectors for low-energy electrons from penetrating charged particles. An evaluation was made of the sensitivity and background components of the electron spectrometer RIE-204 in the orbits of the Kosmos-261 and Kosmos-348 in the earth's magnetosphere. (tr-auth)

10253 UNDOPED SEMI-INSULATING CADMIUM TELLURIDE FOR γ-RAY DETECTORS. Triboulet, R.; Marfaing, Y.; Cornet, A.; Siffert, P. (Laboratoire de Physique des Solides, Bellevue, France). Nature (London) Phys. Sci.; 245: No. 140, 12-13(3 Sep 1973).

It is stated that at the present stage of development of CdTe crystals for γ-ray spectroscopy it is necessary to compensate the material in order to reach the low carrier concentration required. Such compensation is usually achieved with In or with halogens, but this has several drawbacks. The presence of added impurities gives rise to deep trapping levels and affects the product mobility lifetime. In compensation leads to non-uniformities, and Cl and In are probably responsible for polarization effects. A process is described that was developed to grow semi-insulating CdTe without intentional doping and with very low impurity concentration. γ-ray spectra obtained with counters prepared from this material are shown, revealing marked improvement. The method of preparation is described in detail. It is estimated that the total impurity concenrtation in the final crystals does not exceed $10^{15}/cm^3$, this approximately representing the compensated native defect concentration, and it has been demonstrated that it is possible, without intentional doping, to prepare crystals of low carrier concentration ($\leq 10^{11}/cm^3$) suitable for γ-ray detectors. Several counters have been manufactured with samples 2 to 4 mm. thick and of area 30 to 100 mm^2. After standard surface treatments two Al contacts were deposited by evaporation on the opposite faces. The best detection characteristics were achieved with crystals grown at 700°C. No polarization effects were evident. (UK)

10254 CONVENIENT COUNTER FOR MEASURING ALPHA ACTIVITY OF SMEAR AND AIR SAMPLES. Perdue, P. T.; Shinpaugh, W. H.; Thorngate, J. H.; Auxier, J. A. (Oak Ridge National Lab., TN). Health Phys.; 26: No. 1, 114-116(Jan 1974).

A counting system has been designed to overcome the difficulties encountered when using silicon surface-barrier diodes for the measurement of spectra of short lived α-emitters. The system operates at atmospheric pressure with the source placed a minimum distance from the detector. Although this technique allows rapid measurement of the samples and avoids the other problems of measurement in a vacuum, it results in energy loss of the α particles in the air between the source and the detector. The distance cannot be decreased much below 5 mm due to the geometry of the diode and a 6.4 MeV alpha particle will lose about 270 keV in traversing this much air at 760 torr and 20°C. However, by flowing He through the chamber, the energy lost by a 6.4 MeV alpha particle was reduced to about 80 keV. Using helium also reduced the nonlinearity in the energy response of the system caused by the variation of stopping power with energy. Measurements of a ^{239}Pu source made in vacuum, air and helium are compared. Frequent use of the system for a period of a year has demonstrated its stability, resolution and efficiency. One of the principal uses has been the measurement of the ^{222}Rn from decay of its daughters. Also the system has been employed to measure thoron (^{220}Rn) in thorium processing operations, from the daughters trapped on a membrane air filter. In these applications, the vacuum method is both unduly time-consuming and capable of dislodging the alpha-containing dust particles from the filter. (UK)

10255 TWO-CHANNEL HEAT-RESISTING (UP TO 200°C) BOREHOLE INSTRUMENT INCORPORATING SCINTILLATION COUNTERS. Gusarov, D. V.; Pyatakhin, V. I.; Metsger, B. N. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 78-85 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow, Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian)

A heat-resistant two-channel borehole instrument for radiation logging with scintillation counters to 200°C is described. For thermostatic control of the scintillation counters in the instrument a metallic Dewar vessel is used. The principal circuits and the results of bench and borehole tests of the instrument are reported. (tr-auth)

10256 GAMMA SPECTROMETRY SYSTEM FOR SAMPLE ANALYSIS. Rapkin, E.; Thomas, E. W. (to Intertechnique S. A.). US Patent 3,777,144. 4 Dec 1973. Filed date 19 Jan 1972. 8p.

A system is described for measuring the activities of gamma emitters of different energies in successive samples including a transducer, a plurality of linear amplifiers in cascade, and several single channel analyzers. Each single channel analyzer may be connected to the output of any one of the amplifiers by a switch which may also be used to select one of the several preset windows of the corresponding analyzer. (Official Gazette)

10257 VARIATIONS IN ENERGY RESOLUTION AND PULSE HEIGHT IN A NaI(Tl) CRYSTAL BETWEEN +20°C AND −180°C. Tarcan, G. (Univ., Istanbul). Istanbul Univ. Fen Fak. Mecm., Seri C; 35: No. 1-4, 49-54(1970). (In French).

The variations of the energy resolution and the pulse height in a ½ in. × ½ in. NaI(Tl) crystal was studied using the γ rays from ^{198}Au (E_γ = 0.41 Mev). It was established that the energy resolution diminishes linearly when the temperature increases. The temperature coefficient is -0.094 ± 0.03. The pulse height decrease linearly down to −55°C, remains constant from −55°C to −125°C, and then decreases linearly down to −180°C. It was observed that the slope of the two parts of the curve was the same within the experimental error. (tr-auth)

10258 STUDY OF FAST NEUTRON SPECTRA WITH THRESHOLD DETECTORS ON A CRITICAL ASSEMBLY. Lomokin, S. S.; Morozov, A. G.; Petrov, V. I.; Popov, S. G.; Samoilov, P. S.; Fofanov, V. S. pp 23-31 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

A method is described for the measurement of the fast neutron spectra in a fast-thermal critical assembly by means of threshold detectors (Rh, In, Ni, Zh, Fe, Al, and Mg). The fast neutron spectra in the center of the assembly, calculated by iteration methods, are given. The results obtained indicate that the activation detectors are sufficiently sensitive for the measurement in the fast-thermal assemblies and can be used during study of the parameters of the neutron field in the system described. (tr-auth)

10259 PORTABLE Ge(Li) SPECTROMETER FOR THE MEASUREMENT OF X-RAY TUBE VOLTAGES. Wehner, G. PTB Mitt.; 83: No. 4, 238-242(1973). (In German).

A portable planar-drifted Ge(Li) spectrometer for the determination of x-ray tube voltages for licensing is described. From the measured short wavelength limit of the bremsstrahlung spectrum, the tube voltages were ascertained with an uncertainty of ±2 kV. (GE)

High Energy Physics Instrumentation

Refer also to abstracts 10889 and 11685.

10260 (CERN-73-14) STUDY OF SYSTEMATIC AND RANDOM ERRORS OF THE CERN 2 METRE HYDROGEN BUBBLE CHAMBER. Ekspong, G.; Voyvodic, L.; Zoll, J. (European Organization for Nuclear Research, Geneva (Switzerland)). 7 Nov 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

Two circumstances call for a better understanding of errors in bubble chamber experiments. One is the trend towards higher energies where systematic errors are relatively more important than at lower energies. The second is that, even at medium energies, systematic errors may show up when one is dealing with large samples. Previous experience has demonstrated the existence of systematic errors in the measured physical quantities; however, most of this work is not published. Observations have related to systematic errors in a variety of quantities such as beam momentum, secondary particle momenta, and dip angles along tracks, and in losses of the number of kinematically highly constrained events. Two series of exposures were made with the CERN 2 m bubble chamber in order to search for causes of disturbances depending on the operating conditions and to find, if possible, optimized running conditions. In the first series the chamber was filled with deuterium, in the second with hydrogen. Results of the exposures and the methods used for precise error analysis are given. (auth)

10261 (DESY-73-41) BUBBLE GROWTH AND BUBBLE DENSITIES IN BUBBLE CHAMBERS FILLED WITH NEON/HYDROGEN MIXTURES. Horlitz, G.; Wolff, S.; Harigel, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Sep 1973. 30p. Dep. NTIS (U.S. Sales Only) $3.50.

Operating conditions for pure neon and various mixtures of neon and hydrogen have been investigated in the DESY 85 cm cryogenic bubble chamber. Measurements of bubble densities and growth rates for different temperatures and pressures have been made which complement former results in pure hydrogen and deuterium. (auth)

10262 (EFI-18-73) EXPERIMENTAL DETERMINATION AND ANALYSIS OF GEOMETRICAL DISTORTIONS OF VIDEO TUBE IN TELEVISION MEASURING EQUIPMENT FOR TRACK COORDINATES IN SPARK CHAMBERS. Bernshtein, L. I.; Klevalin, V. A.; Petrakov, A. V.; Kharitsnov, V. M. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). 1973. 18p. (In Russian). INIS.

The effect of individual distortion factors on the trajectory of the scanning beam of a vidicon was examined. According to the experimental data obtained by readout of the television automatic device of the coordinates, the systematic errors and the magnitude of the geometric distortion of the solution were determined. The order of magnitude of the approximation polynomial and the period of the overcalibration of the television system were also determined. (tr-auth)

10263 (EFI-ME-16-72) XENON CHAMBERS AND THEIR APPLICATIONS. Ispiryan, K. A.; Magaryan, A. T. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). 1972. 15p. INIS.

The possibility of using liquid xenon for filling detectors for γ quanta and high energy electrons was examined. The advantages of the xenon chamber in comparison with NaI(Tl) counters are noted. Data on the physical properties of liquid xenon at T = −109°C and of NaI(Tl) crystals were tabulated. It was shown that by means of such detectors, reactions in which some π^o mesons are formed can be studied. (tr-auth)

10264 (ITEF-4) HIGH-VOLTAGE POWER SUPPLY FOR NARROW-GAP SPARK CHAMBER WITH AUTOMATIC INFORMATION OUTPUT. Kanavets, V. P.; Morozov, V. B.; Ryl'tsov, V. V.; Sakharov, V. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 18p. (In Russian).

The high-voltage power supply system for spark chambers with automatic data output is described. The power supply guarantees the repeated triggering of the spark chamber by accelerator pulses and steady pulse regime. The high-voltage power supply was designed for operation during millisecond values of the dead time of the spark interval. The absence of storage and flat independence of the amplitude regulation of the high-voltage pulses are characteristic. A simple method for the control of the efficiency of the spark interval is described. (tr-auth)

10265 (ITEF-8) MORE PRECISE DEFINITION METHOD OF OPTICAL AND GEOMETRICAL CONSTANTS OF ITEF LIQUID HYDROGEN CHAMBER 205 AND PRELIMINARY RESULTS OF PHOTOGRAPHY PROCESSING. Aleshin, Yu. D.; Arutyunyats, G. A.; Kiselevich, I. L.; Pletrikov, A. A. (Gosudarstvennyj Komitet po Ispol'Zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 44p. (In Russian). INIS.

Questions on the determination of the geometric and optical constants of the ITEF ZHVK-205 by means of measurements on the coordinates of the crosses plotted on the principal glass of the chamber and of the corresponding points in the working volume of the chamber (interaction apex, end of the track, etc.) were examined. The algorithms of the program for the BESM-4 computer are described. The results of making the constants more precise are reported. The precision obtained in the reconstruction of points in three dimensions is ~50 to 100 μ in the XY plane and ~300 to 400 μ along the Z axis. Preliminary data were obtained on unbalanced parameters for the mass K^* and Λ $M_{K^*} = 500.6 \pm 1.4$ MeV and $M_\Lambda = 1116.8 \pm 0.7$ MeV, which agrees satisfactorily with tabulated values. The mass of the neutron, determined as the deficient mass of the reaction $\pi^- p \rightarrow \pi^- \pi^+ n$ is equal to $M_n = 9.44 \pm 5.3$ MeV. Analogously $M_{\pi^*} = 146 \pm 18$ MeV. (auth)

10266 (JINR-P10-7284) GEOMETRIC RECONSTRUCTION PROGRAM FOR EVENTS IN THE FILMLESS SPARK SPECTROMETER. Vestergombi, D.; Vovenko, A. S.; Deak, F.; Kukhtin, V. V.; Savin, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 39p. (In Russian). Dep. NTIS (U.S. Sales Only) $4.00.

A program for the geometric reconstruction of the decay of neutral kaons, registered by means of a filmless spark spectrometer, is described. The efficiency of the operation of the program was investigated on simulated and real events. Approximately 4 million events registered on magnetic tape were processed with this program. (tr-auth)

10267 (JINR-P10-7460) PROGRAMME FOR DATA STORAGE AND APPARATUS CHECK-UP IN EXPERIMENTS WITH HIGH ENERGY K^0-MESONS. Vovenko, A. S.; Govorun, N. N.; Golutvin, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

The writing, organization, and functions of the KRAN-1 program, used when operating the filmless spark spectrometer on-line with a BESM-4 computer, are considered. (auth)

10268 (JINR-P13-7492) FAST DIGITAL CODER CONNECTED WITH THE CAMAC DATAWAY FOR HODOSCOPE SYSTEMS. Basiladze, S. G.; Guzik, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A digital 32-channel BCD coder is described for the cases when one and only one wire in a proportional chamber is fired. The unit has the possibility to transfer input data via CAMAC dataway. The maximum number of coded channels is up to $(2^8 - 1)$ and the minimum coding time is about 160 ns. (auth)

10269 (LBL-2420) RECENT DEVELOPMENTS IN DELAY LINE READOUT OF MULTIWIRE PROPORTIONAL CHAMBERS. Perez-Mendez, V.; Parker, S. I. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-Eng-48. 10p. (CONF-731112-19). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The application of electromagnetic delay line readout methods for determining the track positions of ionizing particles in multiwire proportional chambers is described. Construction techniques for large area chambers, which allow the use of all three planes for track position measurements are given. The construction and characteristics of electromagnetic delay lines optimized for wire chamber readout are discussed. (auth)

10270 (RL-73-125) CONVERT: THE PROGRAM LINK BETWEEN THE CRYSTAL FILM MEASUREMENT SYSTEM AND THE IBM 370/195. Chapman, W. S. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The FORTRAN program which transfers the output data of the CRYSTAL film measurement (bubble chamber events) system from 7-track magnetic tape to a standard format on a 370/195 data set is described. (auth)

10271 CONSTRUCTION AND PERFORMANCE OF 2m × 4m WIRE SPARK CHAMBERS. Nunamaker, T. A.; Turner, D. B. (Univ. of Chicago). Nucl. Instrum. Methods; 113: No. 3, 445-451(1973).

The construction and performance of wire spark chambers having an active area of 2.0 × 4.0 m^2, and a wire spacing of 1 mm are described. Two pairs of shift register readout planes provide two independent gaps per chamber. Preliminary testing with cosmic rays indicates fwhm resolution of one wire spacing. (auth)

10272 TRACK FITTING METHOD FOR PARTICLES IN NON-UNIFORM MAGNETIC FIELDS. Peters, M. W. (Univ. of Hawaii, Honolulu). Nucl. Instrum. Methods; 113: No. 3, 371-380(1973).

A new method of fitting particle trajectories in non-uniform magnetic fields is described. It is assumed that measured points in three-dimensional space have already been obtained. The trajectory is broken into segments within which the magnetic field may be regarded as a linear function, for which an approximate analytic form of the trajectory is derived. With this form and its derivatives, a Newton–Raphson iteration is carried out to minimize the sum of the squares of deviations of observed points from the trajectory. The method described has been used in a spark chamber experiment investigating K_{e4} and $K_{\pi ee}$ decays. (auth)

10273 PERFORMANCE OF A LARGE STREAMER CHAMBER IN EXTENSIVE AIR SHOWERS. Kanofsky, A. S. (Lehigh Univ., Bethlehem, PA); Tutin, M.; Chen, K. W. Nucl. Instrum. Methods; 113: No. 3, 363-369(1973).

The operating parameters and performance of a large streamer chamber used in a cosmic ray extensive air shower experiment are described. Track densities greater than 500/m^2 were observed in the chamber. The mean streamer density was found to decrease gradually as the track density increased. The standard deviations of the observed streamer densities were larger by a factor of 1.2 to 1.7 than what was statistically expected. (auth)

10274 SIMPLE MAGNETIC SPECTROMETER FOR COSMIC RAY STUDIES TO 300 GV. Golden, R. L. (Johnson Space Center, Houston, TX); Adams, J. H.; Marar, T. M. K.; Boykin, W. R.; Marbach, J. R.; Neumann, W. R.; Deney, C. L.; Hintz, R. E.; Heckman, H. H.; Lindstrom, P. J. Nucl. Instrum. Methods; 113: No. 3, 349-361(1973).

The first balloon-borne cosmic ray experiment incorporating a superconducting magnet is described. The rigidity measuring apparatus consists of an array of emulsion coated glass sheets mounted in the 10 kG field of a superconducting magnet. The 50 cm^2-ster experiment has been successfully flown 4 times yielding rigidity spectra to ~300 GV. The emulsion apparatus is described in detail. Features of the magnet construction and operation are presented. The calibration and data analysis procedures used throughout the experiment are discussed. (auth)

10275 OBSERVATION OF RELATIVISTIC RISE IN THE ENERGY LOSS IN PLASTIC SCINTILLATOR. Gabriele, S. A.; Giusti, P.; Massam, T.; Palmonari, F.; Valenti, G.; Zichichi, A. (CERN, Geneva). Nucl. Instrum. Methods; 113: No. 3, 465-468 (1973).

In comparing pulse height spectra from protons of momentum 13 GeV/c and 20 GeV/c, a rise of $(1.54 \pm 0.29)\%$ in the average energy loss in plastic scintillator has been observed. (auth)

10276 DEPLETED ELECTRON COLUMNS IN CURRENT-LIMITED SPARK CHAMBERS. Bull, R. M.; Youle, J. H. (Univ. of Nottingham, Eng.). J. Phys., D (London); 6: No. 16, 1929-1940 (26 Oct 1973).

Experimental results of the efficiency of current-limited spark chambers as a function of pulse delay are described for various types of chambers. These results are presented partially for their direct application to extensive air shower research, but primarily with a view to clarifying the spark mechanism operative in these chambers. A phenomenological theory describing the efficiency-pulse delay relationship is derived and compared with the experimental data. The results of this comparison are discussed and their relevance to a theory of the spark mechanism emphasized. (auth)

Radiometric Instruments

10277 (INIS-mf-919) LEVEL DETECTOR FOR LIQUID METALS. de Amorim Marino, R. C.; de Mello, H. A. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). Nov 1972. 25p. (In Portuguese). INIS.

The design made by the Instrumentation and Control Division of the Institute of Nuclear Energy of a portable instrument for indication of the level of liquid metals is described. (INIS)

10278 (TRITA-KKE-7302) REPORT TO THE NATIONAL ENVIRONMENTAL PROTECTION BOARD 1971–1972 (DEVELOPMENT OF ANALYTICAL METHODS FOR MERCURY, CADMIUM). Westermark, T.; Forberg, S. (eds.). (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Kaernkemi). Feb 1973. 62p. (In Swedish). Dep. NTIS (U.S. Sales Only) $5.25.

A separate abstract was prepared for each of two sections of

the report. The remaining thirteen sections were not in the subject scope of NSA. (TFD)

For abstracts of individual sections see: 9831 and 10279.

10279 (TRITA-KKE-7302, pp 51-56) RADIOMETRIC MEASURING METHOD FOR EGG SHELLS. Forberg, S.; Svaerdstroem, K. Feb 1973. (In Swedish).

A description is given of a fast nondestructive radiometric method for registration of the thickness of egg shells of the tawny owl, hen, osprey, and Canada goose. Certain errors are discussed. Measurement of the thickness of egg shells (mineral content per cm^2) with an accuracy better than 1% is possible in less than one minute under field conditions. (auth)

10280 RADIOMETRIC LIQUID LEVEL GAUGE WITH LINEAR-DETECTION. Glaeser, M.; Emmelmann, K. P. (Institut fuer Mechanisierung, Potsdam, Ger.). Isotopenpraxis; 9: No. 9, 318-322(Sep 1973). (In German).

A description is given of a radiometric liquid level gauge with linear detection. It consists of a set of radioactive sources (e.g., ^{137}Cs) with quadratic graduation in their activities, of a scintillation counter with electronic back-up unit and of a slender tube. The tube, sources and scintillation counter form a compact and easily transportable liquid level gauge. It is especially adapted for liquid level measurements in slender, difficulty accessible and opaque containers. The device supplements the different methods for liquid level measurement with a new variant which is adopted for many cases in practice. (auth)

10281 PROCESS FOR PREPARING NUCLEAR HARDENED SEMICONDUCTOR AND MICROELECTRONIC DEVICES. Cates, H. T.; Darling, R. E. (to Martin-Marietta Corp.). US Patent 3,769,693. 6 Nov 1973. Filed date 16 Jul 1971. 12p.

A process is described for preparing nuclear hardened semiconductor or microelectronic devices consisting of: (1) determining the electrical characteristics of semiconductor or microelectronic devices; (2) designating the electrically acceptable semi-conductor or microelectronic devices; (3) exposing said acceptable semiconductor or micro-electronic devices to a neutron environment; (4) determining the electrical characteristics of said exposed semiconductor or microelectronic devices; and (5) annealing the neutron environment electrically acceptable semiconductor or microelectronic devices. (Official Gazette)

10282 INFLUENCE OF SOIL DENSITY ON THE READING OF NEUTRON MOISTURE METERS. Emel'yanov, V. A.; Beskin, L. I. Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.; No. 48, 32-43(1970). (In Russian).

The theory of neutron moisture gages is discussed and literature data are presented to illustrate the effect of soil density on their readings. (TFD)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 10105 and 10617.

10283 (CONF-720948-, pp 215-225) EMITTANCE MEASUREMENTS OF A PROTON BEAM AS A FUNCTION OF DUOPLASMATRON SOURCE PARAMETERS. Curtis, C. D. (National Accelerator Lab., Batavia, IL). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A duoplasmatron with plasma expansion cup and an accelerating column with Pierce geometry can deliver a beam current up to 250 mA at 750 keV to a proton linac. Beam measurements are given for a few variations in the extraction geometry. Emittance is plotted as a function of beam current, extraction voltage and various source parameters including magnetic field, gas pressure and bias voltage on the expansion cup liner. Shown among the results are an improvement of emittance with a negative cup bias and a slow increase of brightness with increasing beam current. (auth)

10284 (SLA-73-615) RADIATION-PRODUCED ELECTROMAGNETIC RESPONSE OF A DIELECTRIC-FILLED CYLINDRICAL CAVITY: COMPARISON OF THEORY AND EXPERIMENT. Brumley, F. B.; Evans, D. C.; Mangan, D. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 37p. Dep. NTIS $4.00.

The electromagnetic response of a dielectric-filled finite-length cylindrical cavity, exposed end-on at the Hermes II radiation facility, is experimentally and theoretically examined. Loop sensors were used to obtain azimuthal-magnetic-field-related signals, and a dipole grid sensor was employed to acquire axial-electric-field-related signals. Both the experimental concept and the theoretical modeling are discussed in detail. The favorable comparison achieved between the experimentally obtained signals and the theoretically predicted results lends credence to the theoretical model developed. It was attempted to understand the electromagnetic response of a cavity driven by a radiation pulse for the effective design and assessment of the reliability of electronic packages and components which must perform within or after exposure to intense radiation fields. (auth)

10285 TRANSIENT IONIZING RADIATION EFFECTS IN IMPATT DIODES. Cottrell, P. E. Troy, NY; Rensselaer Polytechnic Inst. (1973). 207p. University Microfilms Order No. 73-27,199.

Thesis (Ph.D.).

The effect of transient ionizing radiation on IMPATT diodes is experimentally and theoretically evaluated. The major effect of this radiation is creation of a bulk leakage current which for radiation dose rates greater than 10^8 rads/sec significantly reduces the diode output power and increases the frequency of oscillation during the radiation pulse. A large signal circuit model is derived which predicts the effects of this leakage current. GaAs and silicon IMPATT diodes with rated output powers of 500 mW were tested by irradiation with single 100 nsec pulses of 10 MeV electrons at dose rates of 10^8 to 4×10^8 rads/sec. The diodes were mounted for testing in an evacuated waveguide cavity with a measured external Q of 100 and one silicon diode was tested in a cavity with an external Q of 2000. The diode output power, frequency of oscillation and voltage were monitored before, during and after the radiation pulse by an RF measurement apparatus which included a unique phase discriminator for measuring the diode oscillation frequency during the radiation pulse. In vacuum at bias current densities of 300 to 420 A/cm^2 the RF output power of several hundred milliwatts was reduced by 3 dB during the radiation pulse for dose rates of 1 to 1.5×10^9 rads/sec. The RF power decreased 7 dB at these bias current densities by dose rates of 3 to 4×10^9 rads/sec. The diode frequency of oscillation typically increased by 10 to 25 MHz at a dose rate of $.5 \times 10^9$ rads/sec in the cavity with an external Q at 100 and by 3 MHz in the cavity with an external Q of 2000. A large signal circuit model including the leakage current was derived as an extension of the approach taken by K. Mouthaan. The expected behavior of the IMPATT diodes with leakage current was evaluated using the large signal circuit model and the leakage current calculated from the measured radiation dose rate and total depletion volume. For all diodes the measured and predicted RF power versus bias current for various dose rates-leakage currents agreed within the limit of experimental error. The frequency shift during the radiation pulse was found to be proportional to the predicted change in diode impedance by a constant justifiable by qualitative analysis of the RF circuit. (Diss. Abstr. Int., B)

10286 ELECTROMAGNETIC PULSE (EMP). pp 37-38; 40 of ITEM 1973. Interference Technology Engineer's Master Directory and Design Guide. Plymouth Meeting, PA; R and B Enterprises (1973).

The effects of an electromagnetic pulse (EMP) on electronic equipment and protection methods are discussed. (TFD)

10287 DAMAGE EFFECTS IN SILICON SURFACE BARRIER DETECTORS BY 0.5 TO 1.5-MeV ELECTRONS. Nakamoto, S. (Chubu Inst. of Tech., Kasugai, Japan); Kawabata, K.; Norisawa, K.; Sakisaka, M. Jap. J. Appl. Phys.; 12: No. 10, 1493-1499(Oct 1973).

The effects of radiation induced defects on the property of silicon surface barrier detectors were investigated. Experiments on current-voltage and capacitance-voltage characteristics were carried out with the following results: (1) the introduction rate of the defects was proportional to the square of the energy of incident electrons, and (2) the extension of depletion layer thickness was recognized as a function of electron flux. The effect on detector property is discussed in terms of trapping effects of excess carriers induced by alpha and beta rays. It is concluded that divacancies which act as acceptors in n-type silicon are most likely defects to explain the experimental observations. (auth)

Miscellaneous Instruments

Refer also to abstracts 10677, 10773, 11417, 11857, 11907, 11949, 12125, 12415, and 12463.

10288 (ANCR-1130) VARIABLE RELUCTANCE DISPLACEMENT TRANSDUCER TEMPERATURE COMPENSATED TO

650°F. Piper, T. C.; Colson, J. B. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1973. Contract AT(10-1)-1375. 16p. Dep. NTIS $4.00.

A variable reluctance transducer (VRT) with ± 0.100-inch stroke to operate to 650°F is described. Specific design effort was taken to optimize the design to have minimum change in the VRT's null and sensitivity with rapid thermal and pressure transients. Null and sensitivity stabilities of ± 0.5% and 1.8% of full scale, respectively, were obtained. Appendices delineate the various effects considered in optimizing the design. (auth)

10289 (ANL-CT-73-16) LONG-TERM STABILITY OF ALNICO 5 AND 8 MAGNETS AT 700 TO 1200°F. Forster, G. A. (Argonne National Lab., Ill. (USA)). Nov 1973. 29p. Dep. NTIS $3.50.

Tests performed to determine the long-term stability of Alnico 5 and 8 magnets for use in permanent magnet in-core sodium flowmeters are described. The results of this experiment showed that two processes combine to affect magnetic stability of these magnets at temperatures above 700°F: loss of field strength with time, the rate of loss increasing with temperature, and partial recovery of the loss caused by a high-temperature stabilization. The conclusion is that for a given temperature the most stable performance will be obtained by balancing these two processes with an optimum stabilization procedure. This procedure has yet to be established. For 12,000-hr operation, the recommended maximum temperatures are 1000°F for Alnico 5 (< ±10% drift), and 1100°F for Alnico 8 (< ±15% drift). (auth)

10290 (BARC-694, pp 145-147) DISTORTED SINGLE CRYSTALS AS NEUTRON MONOCHROMATORS. Thaper, C. L.; Dasannacharya, B. A.; Iyenger, P. K. 1973.

10291 (CONF-720948-, pp 689-695) HOLLOW CATHODE ION SOURCE STUDY FOR IONIZATION OF FISSION PRODUCTS. Gautherin, G. (Faculte des Sciences, Orsay, France); Zirnheld, J. P.; Schutz, L. 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The ion source described should be able to ionize short lives fission products (T ≃ 0.1 s) so as to separate them with the aid of a magnetic analyzer and to study their nuclear properties in using conventional methods of spectroscopy. The basis of the experiment is schematically the following: A ^{235}U target is placed at the center of a reactor giving a 10^{12} n/cm^2/s flux inside of a sealed container filled with gas under pressure. The fission fragments are slowed down, then flowed out together with the gas through a capillary tube which ends in an ion source leading to their ionization. These fragments can next be separated by means of a deviation magnet. Theoretically, one should be able to collect all the masses which are obtained in the fission reaction. The requirements of this kind of experiment which lead to the choice of a hollow cathode source are discussed. Some preliminary results are presented. They consist of a study of the main characteristics of the ion source and its capacity for on line ionization of metallic particles. (auth)

10292 (FEI-382) CONNECTION OF A MEASURING CENTER WITH AN ELECTRONIC COMPUTER. Kabenin, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 21p. (In Russian). INIS.

The organization of the connection of a measurement center, serving groups of nuclear-physical experiments, with a Type M-220 computer was examined. The connection was accomplished by a multipair telephone cable by means of a special installation, coordinating the work of the measurement center and the computer. Means for the automatic distribution of the work time of the computer between several users were provided. Special attention was given to the flexibility of the interaction of the computer with the measurement center and to an increase of the reliability of the functioning of the system. (tr-auth)

10293 (ITEF-2) NANOSECOND MULTICHANNEL COINCIDENCE CIRCUIT. Fedorov, V. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 14p. (In Russian). INIS.

A multichannel coincidence circuit with a resolution of the order of several nanoseconds is described. The circuit uses tunnel diodes with bias in the reverse direction as a coincidence selection element. The relations permitting the selection of the most advantageous operating regime for the tunnel diodes with a maximum number of coincidence channels were determined. (tr-auth)

10294 (KFK-1873) CAMAC SYSTEM CONTROLLER FOR PROCESS COMPUTER TYPE TELEFUNKEN TR86. Gruber, P. H.; Ottes, J. G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Labor fuer Elektronik und Messtechnik). Oct 1973. 74p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

A system controller capable of driving a full CAMAC Branch as interface to a Type TR86 Telefunken computer is described. The device can handle single operations, four different modes of block transfers and fast autonomous transfers using cycle stealing techniques. There are 8 Interrupt and 16 DMA-channels available. Each of up to seven crates is connected to an interrupt channel; the last channel is for use of the system controller. The device was tested during start up and run time of the "Neutral Resonances" experiment at the accelerator in Serpukhov, USSR. (auth)

10295 PROTON-RESONANCE MAGNETIC FIELD STABILIZER USING A FREQUENCY STABILIZER. Kumabe, I.; Takiguchi, A.; Nakamura, H. (Kyushu Univ., Fukuoka). Nucl. Instrum. Methods; 113: No. 3, 387-393(1973).

A proton-resonance magnetic field stabilizer using a frequency stabilizer was designed and constructed. The frequency of an RF oscillator is stabilized by means of a new frequency stabilizer which consists of a frequency counter, a thumb rotary switch, a BCD subtractor, a DA converter and a varicap located in the tank circuit of the oscillator. The frequency stability of $<1 \times 10^{-6}$/h was obtained in this system. The magnetic field stabilizer consists of mainly the RF oscillator, a preamplifier, a selective band amplifier, a phase sensitive detector, a DC voltage amplifier, a DC power amplifier, a stabilization coil and an LF oscillator. This system was simplified by the use of many integrated circuits and IC power packs. The stability of this magnetic field stabilizer was measured to be $<2 \times 10^{-6}$/h. (auth)

10296 APPARATUS FOR DETERMINING THE COMPRESSION STRENGTH OF SPHEROIDAL MATERIAL MADE OF URANIUM, THORIUM, AND PLUTONIUM MIXED OXIDES AND THE LIKE. Gambini, A. (to Snam Progetti S. p. A.). US Patent 3,771,357. 13 Nov 1973. Priority date 19 Dec 1969, Italy. 4p.

An apparatus is described for automatically determining the compression strength of spheroidal materials. The device consists of an electromagnet having a vertically moving element and adjustment means to provide an air gap, a power winding for exciting the moving element magnetically coupled to a control winding which generates a pulse stopping the exciting current to the power winding when the spheroidal material breaks and means for amplifying and detecting the pulse generated by the control winding and correlating the value of the excitation current with the compression strength of the sample. (Official Gazette)

10297 USE OF A LABORATORY DATA PROCESSOR FOR THE PRESENTATION OF SURFACE SCANNING DATA. Pierce, T. B.; Peck, P. F.; Haines, K. (Atomic Energy Research Establishment, Harwell, Eng.). J. Radioanal. Chem.; 14: No. 2, 387-393(Apr 1973).

A small laboratory data processor has been used to simplify presentation of information from positive ion microprobe surface scanning studies. Display options include number pattern, isometric and multi-color contour forms. (auth)

10298 USE OF IN-PILE COLLIMATORS IN INELASTIC NEUTRON SCATTERING. Klaus, J. (Technische Univ. Munich, Garching, Ger.); Dorner, A. Acta Crystallogr., Sect. A; 29: No. 5, 526-528(1 Sep 1973).

The influence of an in-pile collimator is shown for two cases: (a) Divergence α_0 of the incoming beam large compared to the mosaic width η of the monochromating crystal and the divergence α_1 after the crystal ($\alpha_0 > \eta, \alpha_1$); and (b) $2\eta > \alpha_0, \alpha_1$. If the same energy resolution for a three-axis spectrometer is required, an optimized comparison of the counting rates in these two cases reveals a factor of two in favour of case B. This is an important reduction in measuring time for investigations of horizontal dispersion branches, for quasielastic and incoherent scattering, where only the energy (no momentum) resolution is concerned. (auth)

10299 INSTRUMENTATION OF COMPLEX SYSTEMS. Tait, D. R. (CAE Electronics Ltd., Montreal). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-205.

As systems grow in complexity, it is increasingly difficult to provide cost effective instrumentation through the use of traditional techniques. The advantages that can be derived from inclusion of a digital computer in data acquisition systems and in remote system annunciators have been established. The increased application of automatic control techniques can aggravate the instrumentation problem in two ways as follows: (a) by reducing the size of the system operating staff, and (b) by adding the requirement that the status of the automatic system and its components be displayed. Cathode ray tube display systems offer an effective solution which has by no means been fully exploited.

Operational efficiency can be enhanced by such techniques as variable format, color, brightness changes and flashing characters. (auth)

10300 MEASURING ATMOSPHERE PRESSURE BY MEANS OF RADIOACTIVE EMITTERS. Kozlov, O. V.; Polenov, B. V.; Khazanov, B. I. pp 106-115 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

Some methods for the measurement of the pressure in the range from 40 to 760 mm Hg by means of radioactive emitters from the mean free path and specific energy loss of α particles and by scattering of β particles are presented. The technical characteristics and the possible range of utilization of similar methods are indicated. (tr-auth)

10301 DATA ACQUISITION SYSTEM BASED ON CAMAC AND SUPPORTED BY BASIC AND FORTRAN. LePatourel, D. A.; Johnson, R. R.; Marquardt, D.; Gurd, D. (Univ. of British Columbia, Vancouver). CAMAC Bull.; No. 8, 7-10(Nov 1973).

A 12k minicomputer has been used with CAMAC and NIM equipment in an intermediate-energy nuclear scattering data acquisition system. The system is programmed in BASIC or FORTRAN, with sub-routines for input/output via CAMAC. The version with BASIC is most useful to experimenters, except where higher data rates require the use of FORTRAN. (UK)

10302 CALCULATING A GAMMA-RELAY. Zlatarov, V.; Ivanov, R. Elektroprom. Priborostr.; 7: No. 7, 254-257(1972). (In Bulgarian).

A method is proposed to design a gamma-relay by means of nomograms. The theory of the radioisotope gamma-relay is treated in many papers using mathematical statistics and theory of probability. General drawback of these methods is the complicated and tedious work involved in calculations. In this paper a quick and easy method is proposed. The methods for dimensioning the parameters of the gamma-relays are discussed, when the activity of the radioactive source changes considerably during use. A classification of the general design formula is done. On this basis nomograms are prepared by means of which the dimensioning of the basic parameters of gamma-relays is easily done. (INIS)

10303 CALCULATION OF CERTAIN BASIC PARAMETERS OF THE RADIOISOTOPE GAMMA-RELAY. Traikov, I.; Vasilev, V. Elektroprom. Priborostr.; 7: No. 5, 176-177(1972). (In Bulgarian).

In many cases the production process is controlled by means of radioisotope gamma-relays. Usually the following scheme is used: the radioactive source energizes a counter on whose output appear electrical pulses, which, after amplification, operate an electromagnetic relay. If we now place some absorbent material between the source and the counter, the number of gamma-quantam reaching the counter is reduced and the electromagnetic relay comes to its initial state. Because of the statistical character of the gamma radiation the output signal would not be constant but would fluctuate about a mean value. To reduce these fluctuations, an integrating circuit is introduced. The time constant of this circuit is inversely proportional to the amplitude of these fluctuations, i.e.; the smaller the fluctuations the greater the time constant. The fluctuations of the input signal could cause improper action of the electromagnetic relay. To prevent this, the number of the output pulses should be considerably greater than the fluctuation pulses. This is directly connected with the proper time constant of the circuit. A method is proposed to calculate the proper time constant in function of the radiated pulses, thus calculating the activity of the source. (INIS)

10304 GRAPHICAL METHOD FOR GAMMA-RELAY CALCULATIONS. Traikov, I.; Vasilev, V. Elektroprom. Priborostr.; 7: No. 6, 217-220(1972). (In Bulgarian).

Following general theoretical considerations a graphical method is proposed for designing gamma relays. By this method the basic parameters of the relay can be determined easily and quickly. Since the calculating formulas are applicable for definite conditions, depending on different constant parameters defined by the type of the source and the counter used, the graphical method proposed can be utilized for calculations only when ^{60}Co, ^{137}Cs, and ^{170}Tm sources are encountered. For the graphical dimensioning of a gamma relay it is necessary to know the kind of absorbents and their relative weights per unit surface. This concerns also the boundary walls where the radiation comes through. Then the appropriate source is chosen. By means of given graphs, the time constant of the relay and the coefficient of reduction of the radiation are defined. Another graph shows, for a definite distance, the activity of the source which, if not appropriate, could be corrected. Then the screen could be defined, choosing its type and thickness. The method proposed is convenient for practical purposes, avoiding tedious radiometric calculations. (INIS)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 12168.

10305 (CONF-720948-, pp 844-849) SURFACE IONIZATION SOURCE OF ORSAY ISOTOPE SEPARATOR. Kotfila, L.; Krupa, J. C.; Nguyen, L. D.; Obert, J. (Institut de Physique Nucleaire, Orsay, France). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The last version of the surface ionization ion source at the Orsay electromagnetic isotope separator and its performance is discussed. The chemical separation of cesium from other elements was performed directly inside the ion source. This technique based upon the differences of volatility and ionization potentials allows one to directly obtain different cesium isotopes produced by nuclear reactions induced in lanthanum targets. (auth)

10306 (NP-19864) URANIUM ENRICHMENT IN THE NETHERLANDS. Kelling, F. E. T.; Lindhout, A. H.; van de Wijngaert, B. H.; van der Stoel, M. (Stichting Reactor Centrum Nederland, The Hague (Netherlands)). 1973. 40p. (In Dutch). Dep. NTIS (U. S. Sales Only) $4.00.

A separate abstract was prepared for each of the four papers in the report. (TFD)

For abstracts of individual papers see: 10307–10310.

10307 (NP-19864, pp 7-22) METHODS OF URANIUM ENRICHMENT. Kelling, F. E. T. 1973. (In Dutch).

In uranium enrichment in the Netherlands.

The principles and different methods of isotope enrichment are reviewed, with emphasis on the gas centrifuge. A comparison of three methods competing with each other is included. (auth)

10308 (NP-19864, pp 23-30) HISTORY OF ULTRACENTRIFUGE DEVELOPMENT IN THE NETHERLANDS. Lindhout, A. H. 1973. (In Dutch).

In uranium enrichment in the Netherlands.

A description is given of the history of research and development work carried out in the Netherlands on the gas centrifuge method for uranium enrichment, from the initial fundamental research to the building of an enrichment plant. Included is a brief description of the cooperation with England and West Germany. (auth)

10309 (NP-19864, pp 31-40) DUTCH PILOT PLANT FOR THE ENRICHMENT OF NATURAL URANIUM BY MEANS OF ULTRACENTRIFUGES. van de Wijngaert, B. H. 1973. (In Dutch).

In uranium enrichment in the Netherlands.

A description of the Dutch pilot plant for the fabrication of gas centrifuges is given. An enrichment plant using ultracentrifugation is also described. (auth)

10310 (NP-19864, pp 41-43) ULTRACENTRIFUGE PROJECT AND THE SPREAD OF NUCLEAR WEAPONS. van der Stoel, M. 1973. (In Dutch).

In uranium enrichment in the Netherlands.

The availability of enriched uranium resulting from the development of the ultracentrifuge offers the opportunity of the use of the uranium in nuclear weapons. The treaty provisions which prevent this are briefly considered. (JSR)

10311 DESIGN PECULIARITIES OF IDEAL CASCADES HAVING ARBITRARY ENRICHMENT PER STAGE. Laguntsov, N. I. At. Energ. (USSR); 35: No. 3, 205-207(Sep 1973). (In Russian).

In a study of the design peculiarities of ideal cascades having arbitrary enrichment per stage, a symmetric cascade was selected for simplicity. Equations are developed for use in the calculation. (MWG)

10312 CENTRIFUGAL GAS SEPARATOR. Takashima, Y.; Endo, Y.; Saitou, K. (to Tokyo Shibaura Electrical Co.). US Patent 3,774,376. 27 Nov 1973. Priority date 17 Jun 1970, Japan. 8p.

A centrifugal gas separator is described which employs a cylindrical centrifuge drum having a hollow shaft mounted on suitable bearings within a housing. Supply means are provided for feeding a mixed gas to be separated into the drum. The supply means has openings located radially near the inner periphery of the drum and axially at approximately the center of the drum. Each opening in the supply means communicates with the hollow shaft. Thus the mixed gas to be separated enters the centrifuge drum near the inner periphery thereof, and the gas is then able to attain a relatively high angular velocity, whereby the separating power of the centrifuge is elevated. (Official Gazette)

10313 METHOD OF AND APPARATUS FOR THE SEPARATION OF ISOTOPES. Levy, R. H.; Janes, G. S. (to Jersey Nuclear-Avco Isotopes Inc.). US Patent 3,772,519. 13 Nov 1973. Filed date 25 Mar 1970. 20p.

An apparatus for the separation of an isotope from a working medium wherein a beam of atoms comprising the working medium may be generated in an oven and collimated with a suitable collimator is described. The collimated beam of atoms is directed through an evacuated region where two photon beams are applied to the beam and function respectively to excite and ionize a selected isotopic constituent of the atomic beam. The ionized isotope may then be removed from the atomic beam by electric or magnetic fields and collected on a collecting plate. (Official Gazette)

10314 FUTURE STRUCTURE OF THE URANIUM ENRICHMENT INDUSTRY. Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Third Congress, First Session, on Actions Necessary to be Taken to Insure Supply of Enriched Uranium Sufficient to Meet Present and Future Needs, July 31 and August 1, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 197p. GPO.

Testimony by AEC and other government officials on the future plans for the uranium enrichment industry is presented. The purpose of the hearings was to examine the industry in respect to its ability to supply the future need for enriched uranium. (TFD)

10315 HEAVY WATER. Haywood, L. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp vp of Proceedings of the 1972 Annual Conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-305.

Despite a slow start, a substantial heavy-water production capacity is now being established in Canada. Heavy water will continue to be in short supply through 1974. Production through 1976/77 is expected to provide enough heavy water to supply inventory for the Bruce station on schedule and during 1977/78 for as yet uncommitted reactors capable of producing power for several hundred megawatts of electricity generation. Commitment of another heavy-water plant within the next 12 to 18 months is considered necessary and likely. (auth)

10316 ION-OPTICAL SYSTEM FOR MASS SEPARATION. Chavet, I. (to Israel Atomic Energy Commission). US Patent 3,774,026. 20 Nov 1973. Priority date 17 Oct 1969, Israel. 10p.

An ion optical system for use with a magnetic prism with a gap of width g and having an ion beam which is arranged to emerge from an elongated object slit and whose maximum angular dispersion $\Delta\beta_{max}$ is smaller than g/l' where l' is the distance between the object slit and the effective entry boundary of the magnetic field associated with the magnetic prims is described. The system comprises means for causing the ion beam to converge in the vertical plane, so as to focus axially substantially into a line located substantially at the effective entry boundary of the magnetic prism. (Official Gazette)

10317 SOUTH AFRICA'S POSITION IN THE WORLD'S NUCLEAR ENERGY PICTURE. Com. Naz. Energ. Nucl., Notiz.; 19: No. 7, 35-43(Jul 1973). (In Italian).

South Africa, which is known to be one of the world's largest uranium producers, had announced in July 1970 that it had developed a new uranium enrichment process and that construction of a pilot plant was under way. The nature of this process is kept strictly secret. In an address delivered at the Annual Meeting of Industrialists and Managers of the Afrikaanse Handelsinstitut, held in Johannesburg on May 1, 1973, Dr. A. J. A. Roux, Chairman of the Atomic Energy Board and of the Uranium Enrichment Corporation of South Africa, made some comments on the project. While retaining secrecy about the nature and features of the project, South Africa's position in the world context, especially as regards uranium enrichment, is defined. (auth)

10318 MARKET FOR URANIUM ENRICHMENT IN WESTERN EUROPE. Atomwirt., Atomtech.; 18: No. 11, 534-535(Nov 1973). (In German).

A numerical assessment is given of the development of the installed nuclear power plant capacity and of the required amount of separative work for the years 1971 to 1985, broken down ac-

cording to the various countries in Western Europe. Moreover, figures describing the toll enrichment (contracts concluded and amounts to be delivered) are given for the period 1972 to 1985. (GE)

10319 ENRICHED URANIUM IMPORTS INTO THE EEC COUNTRIES IN 1972. Atomwirt., Atomtech.; 18: No. 11, 527-528(Nov 1973). (In German).

Parts of a survey published by the Statistical Office of the European Communities, entitled "The Supply of the ECC Countries with Enriched Uranium" are given and briefly commented on. The main data and figures on the final utilization of the enriched uranium imported by the EEC countries in 1972 are shown in tabular form. (GE)

10320 CALCULATION OF THE STAGE HEIGHT OF COLUMNS WITH EFFECTIVE TOWER PACKINGS. Kaminskii, V. A.; Giorgadze, N. A. Isotopenpraxis; 9: No. 1, 1-5(Jan 1973). (In Russian).

Calculated values of the subject stage heights agreed well with experimental values for large loads. For small loads, the calculated curves were below the experimental points, which may be explained by the less uniform distribution of the liquid with the low liquid film rate. (tr-auth)

10321 PICKERING RUNNING 'ROUND THE CLOCK. Nucl. Can.; 13: No. 5, 5(Jul 1973).

A new five-tower heavy-water distillation plant at Ontario Hydro's Pickering Generating Station is briefly described. Designed to restore down-graded heavy water from the Pickering reactors and eventually from other Canadian nuclear stations as well, the plant went on stream in February, 1973. The output of 99.77% D_2O depends on the dilution of the water received from the reactors, with yields as high as 115 kg/h possible from heavy water down-graded to 65%. (CA)

10322 DEVELOPMENTAL POTENTIAL OF THE ISOTOPE SEPARATION NOZZLE METHOD FOR THE ENRICHMENT OF ^{235}U. Becker, E. W.; Bier, W.; Bley, P.; Ehrfeld, U.; Ehrfeld, W.; Eisenbeiss, G. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 1, 524-527(Nov 1973). (In German).

From reactor meeting; Karlsruhe, Ger. (10 Apr 1973).

During the last few years, the prototype of an isotope separation nozzle column for the enrichment of ^{235}U has been successfully tested with UF_6. At the same time, the specific energy consumption could be decreased considerably by optimization of the isotope separation nozzle system used. In principle, there are three possibilities: (1) diminution of the expansion ratio, which is necessary to obtain a certain fluid flow condition; (2) use of the kinetic energy still existing in the flow at the end of the bend for a partial redensification of the gas or for the continuation of the separation; and (3) enhancement of the isotopic separation at given pumping power. It is believed that the separation nozzle has a large developmental potential. This assumption is based on the fact that it belongs, like the centrifuge, to those types of separation systems, which theoretically need no energy supply for the conservation of the separation condition. (GE)

10323 MIXING LOSS IN A STEP CASCADE. Kokubu, H. (Sumitomo Atomic Energy Industries Ltd., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 544-550(Sep 1973).

The total value of the separative work provided by separators in a step cascade, in which mixing cannot be avoided, is larger than that provided by a corresponding ideal cascade operated under the same conditions (rate and concentration) of product, feed and waste. This difference in the separative work is due to mixing loss. A method for calculating the mixing loss in a step cascade is proposed, in the case where the separation factor is nearly 1. Calculations using this method reveal that in each step there exists a stage at which no mixing takes place, provided that the value of the cut in the step is nearly the value of the cut minimizing the mixing loss in the step. As the value of the cut in the step deviates from the value of the cut minimizing the mixing loss in the step, the position of the mixing free stage shifts upwards of downwards from mid-position of the step. (auth)

10324 PURELY AXIAL FLOW IN A COUNTERCURRENT GAS CENTRIFUGE. Lotz, M. (Dornier System GmbH, Friedrichshafen, Ger.). Atomkernenergie; 22: No. 1, 41-45(Sep 1973).

The flow in the rotating cylinder of a gas centrifuge is governed by the continuity equation, the Navier-Stokes equations, the conservation of energy and the equation of state of a perfect gas. These equations are linearized with respect to the Rossby number which is the ratio of a typical flow velocity to the peripheral velocity of the cylinder. Exact solutions of the linearized equations are given which represent purely axial flow in a countercurrent gas centrifuge. The solutions constitute a two-parametric manifold, the two parameters being the product rate and the recirculating stream. (GE)

10325 COMPARISON OF THE ADDITION OF HYDROGEN, HELIUM, AND DEUTERIUM GASES IN THE SEPARATION OF URANIUM ISOTOPES ACCORDING TO THE SEPARATION OF NOZZLE PROCESS. Heeschen, G. Karlsruhe, Ger.; Karlsruhe Univ., Ger. (1972). 26p. (In German).

Thesis.

In the separation of uranium isotopes by the separation nozzle process, a mixture of UF_6 with a light addition gas is used as the processing gas. The influence of the additional gases hydrogen, deuterium, and helium on the flow rate of the gas mixture in the nozzle and the separation of the uranium isotopes was studied, particularly on the delay as regards the setting of the barometric density distribution of the UF_6. It is concluded that hydrogen – compared to deuterium and helium – has an advantage because of its inferior friction influence as to the formation of flow in the separation nozzle. However, with high expansion ratios, helium and deuterium show the better behavior with respect to the delay effect. (GE)

Isotopic Power Sources

Refer also to abstract 10693.

10326 (CONF-720613-P2, pp 979-988) SIMULATIONS OF THE RADIOACTIVE DECAY OF ^{228}Th USED IN THE FORM OF ThO_2 AS A HEAT SOURCE FOR THERMIONIC ENERGY CONVERSION. De Bruyne, R. J. E. (KUL, Heverlee, Belg.); Brabers, M. J.; Casteels, F. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

^{228}Th in the form of ThO_2 can be used as a heat source for thermionic conversion. Experiments are described which were performed to simulate the decay of ^{228}Th present as ThO_2 in a tungsten capsule and to determine the compatibility of Th–W–O system, particularly the quasi-binary system ThO_2–WO_3. From these experiments it was concluded that: ThO_2, W and Pb are compatible for long times (>14 days) at 1700 and 2000°C; tungsten can be used efficiently as an oxygen getter in a $^{228}ThO_2$ heat source, in which case primarily ThO_2, $Th(WO_4)_2$, W, and Pb will be present; the decomposition temperature of $Th(WO_4)_2$ is 1640 ± 15°C; a $^{228}ThO_2$ fueled thermionic converter can give a large amount of energy during a relatively short time; and the vaporization of ThO_2 and $Th(WO_4)_2$ is very small if not completely negligible. (LCL)

10327 (ORNL-4932) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1973. Lamb, E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $5.45.

Heat soak periods were completed on four of the ten sets of compatibility couples which were put on test during the previous quarter. The four sets contain a total of 18 couples. Four couples were examined, and tests on the others are in progress. Examination of the Kilowatt Test Source capsule was completed. Four Cm_2O_3/ceramic couples were examined and additional tests are underway. Materials selection and test conditions were finalized for a 15-couple matrix to be initiated during FY 1974. Free energy calculations were made for the reactions of Cm_2O_3 with Pt–26% Rh–8% W, T–111, Hafnalloy 20–20, stainless steel type 316, Ir–2% W, Pt–30% Rh–8% W, and carbon. The equipment assemblies for the helium release, emissivity, vapor pressure, and heat capacity experiments were completed and checked out. A comparison of physical stability was made between two essentially identical Cm_2O_3 pellets, one stored in dry air and one stored in argon. Some degradation of the air-stored pellet was noted but there was no observable change in the pellet stored in argon. Measurements of rate-of-loss of ^{244}Cm from $^{244}Cm_2O_3$ pellets in seawater were made under two sets of conditions – fresh air-saturated flowing seawater at ambient temperature and a fixed volume of boiling seawater. The rate of weight gain in dry air was measured for a hot-pressed Cm_2O_3 pellet of relatively low density. Calcination weight loss measurements and dry air weight gain measurements were made on a fraction of purified curium oxide. Neutron radiation data from the ^{244}Cm source measurement made last quarter were analyzed and compared to literature values. The source was re-analyzed by calorimetry, and the ^{244}Cm content as of date of the radiation measurement was calculated. The equipment for the Cm_2O_3 impact study was stored due to a postponement of this project. Analytical work on the ^{244}Cm product which is currently being used for characterization tests was completed. Two fractions of stored ^{244}Cm residues were processed at the

TRU facility and yielded 77 g of highly pure curium oxide for test work. Calculations of the yield of ^{244}Cm as a function of ^{235}U enrichment in PWR operations were made. The variation in isotopic abundances of the four principal curium isotopes were calculated for five reference reactors. (auth)

10328 CALORIMETRIC MEASUREMENT OF ^{238}Pu SOURCES FOR PACEMAKERS. Musikas, C.; Marteau, M. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 181, 61-66(May 1973). (In French).

The manufacture of isotopic batteries for pacemakers necessitates a precise control of the thermal power of the ^{238}Pu sources employed. The calorimetric method used is presented. The results obtained are compared with those of other laboratories. The specific power of ^{238}Pu subsequently deduced is then compared with specific powers calculated from data found in the literature. (FR)

10329 CLINICAL USE OF ISOTOPE CARDIAC PACEMAKERS. Wagner, J.; Kreutzberg, B. (Univ., Bonn). Therapiewoche; 23: No. 35, 2871-2873(1973). (In German).

Plutonium-238 having a half-life of 86.4 yrs has proved suitable as a long-life energy source for a cardiac pacemaker. The radiation dose of this pacemaker is below the I. C. R. P.-recommended values. As the isotope pacemaker costs three times as much as a conventional pacemaker, the merits of implanting an isotope pacemaker vs. the conventional kind are discussed. A survey is given of the cases in which an isotope pacemaker has been used. (GE)

Radiation Sources

Refer also to abstracts 9778, 9779, 9994, 11657, and 11943.

10330 NEUTRON SOURCES AVAILABLE FOR RADIOBIOLOGICAL RESEARCH. Burger, G. (Gesellschaft fuer Strahlenund Umweltforschung mbH, Munich); Broerse, J. J. (1973). vp.

From symposium on the effects of neutron irradiation upon cell function; Munich, Germany (22 Oct 1973).

A review is given of neutron sources commonly used in neutron radiobiology. The sources were chosen with respect to their quantitative rather than qualitative importance. Correspondingly, only their main physical specifications and some aspects of practical utility are described and not their features referring to radiation quality. The field of medical application of neutrons is essentially neglected and with a few exceptions also no economic and commercial aspects have been considered. The review is selective and completeness was not contemplated. (GE)

10331 RELATIVE MEASUREMENTS OF TOTAL NEUTRON FLUXES OF ISOTOPIC SOURCES IN A FACILITY WITH HYDROGENOUS MODERATOR. Vorob'ev, Yu. A.; Dorofeev, V. P.; Mordovskaya, T. S.; Ugol'tsev, O. A.; Chizhov, V. A. pp 72-77 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

Questions were examined on the methods and errors of measurement of the total flux of isotope sources in installations with hydrogenous moderators. The errors connected with the geometric position of the source in the hollow of the paraffin block and with thermal neutron multiplication were examined. Special attention was given to errors connected with pulse coincidence which was caused by neutrons and γ quanta. (tr-auth)

Design and Fabrication

Refer also to abstracts 9841 and 10788.

10332 DESIGN AND DOSIMETRY OF A STRONTIUM-90–YTTRIUM-90 BETA IRRADIATION FACILITY. Bores, R. J.; Bottinot, P. J. (Brookhaven National Lab., Upton, NY). Health Phys.; 26: No. 1, 99-101(Jan 1974).

The design and dosimetry of a beta radiation facility which can be used to expose seeds, seedlings, other botanical material or small animals to a relatively intense field of beta particles with a minimum of x or γ contamination are described. The source preparation, design of container and the complete Sr–Y facility are described. Dose contour diagrams for three of the 12 irradiation shelves are illustrated and dose rates, expressed as percentages of maximum dose rates in air, for each shelf are given. (UK)

10333 QUASICYLINDRICAL SOURCE. Semenov, P. D. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 6, 897-899(Jun 1973).

Translated from Izmer. Tekh.; 16: No. 6, 65-67(Jun 1973).

The described gamma source is better than one of squirrel-cage type as regards dose uniformity by a factor of 2 to 4, which should result in much more accurate irradiation of grain, and also some saving in source costs. The performance of the source is better than that of existing sources by a substantial factor because there is no self-absorption in point sources, and the accessory chambers provide additional working volume while a proper disposition of the cassettes provides the necessary dose with the minimal possible radius. The quasicylindrical source is also more transportable than others, because of the lower shielding weight, which simplifies the design of gamma sources by reducing the weight and cost by factors of 2 to 3. The quasicylindrical source with 9 cassettes should be used in equipment for irradiating grain, while the source with 13 cassettes, which has elevated uniformity, should be used in determining optimal doses and in performing radiation chemistry and physical studies. (auth)

Industrial Uses

Refer also to abstracts 9931, 10357, 10364, 10369–10371, 10373, 10376, and 10382.

10334 (CEA-CONF-2181) ANALYTICAL APPLICATIONS OF SEALED RADIOACTIVE SOURCES IN THE TEXTILE INDUSTRY. Martinelli, P. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 10 Nov 1972. 20p. (In French). (CONF-721142-1). Dep. NTIS (U.S. Sales Only) $3.00.

Analytical methods using sealed radioactive sources are based on the absorption or diffusion of α, β, and γ rays and neutrons; x fluorescence; and the thermalization and diffusion of neutrons. Each of these methods is described briefly with the emphasis on the exact role each method can play in the textile industry. Typical applications include determination of chlorine in chlorinated fibers, humidity determination, and sorting of spools in weaving installations. (JSR)

10335 (INIS-mf-457) INFLUENCE OF GAMMA IRRADIATION ON THE STABILITY OF NATURAL PIGMENTS IN FOOD. Snauwaert, F. (Institut Belge de l'Alimentation et de la Nutrition 'Iban', Brussels). 1972. 31p. (In Dutch). INIS.

Possible transformation of pigments in food products under the effects of gamma radiation seems to be very important for the application of this preservation technique. Results are presented concerning the stability of coloration of shrimp, peas, and meat. (INIS)

10336 (INIS-mf-888) ATOMIC ENERGY BOARD, SIXTEENTH ANNUAL REPORT, 1972. (Atomic Energy Board, Pelindaba, Pretoria (South Africa)). 1972. 60p. INIS.

The Annual Report of the Atomic Energy Board is presented. The search for nuclear materials continued and was facilitated by the development of an automatically recording scintillation counter coupled to a cyclometer. Further advances were made in the chemical extraction of uranium from ores and instrumentation has been developed to control many of the processes. Work on advanced fast reactor fuels will enter a new stage with the construction of an integrated glove-box line in which batches of advanced fuels can be prepared and fuel pins assembled for irradiation purposes. Economic and environmental studies on the introduction of nuclear power were carried out. The use of isotopes in specific applications was actively encouraged. Work on the fundamental studies progressed satisfactorily. In the computer section a new IBM System/370 Model 155 IH computer was installed. Titles of publications are listed. (INIS)

10337 MEASUREMENTS OF SULFUR SOLUBILITY AND DIFFUSIBILITY IN RUBBER BY TRACER METHOD. Ikeda, M. (Tokyo Metropolitan Isotope Research Center); Yamamoto, T.; Shinozaki, Y.; Wada, N.; Kaneko, Y. Radioisotopes (Tokyo); 22: No. 10, 556-560(Oct 1973).

Solubility and diffusibility of sulfur in rubber were determined at several temperatures by a tracer method using radioactive sulfur. The new absorber method, by which errors due to self-absorption of beta-radiation can always be compensated, was devised for measuring the diffusibility. (auth)

10338 TUBING IRRADIATION PROCESS. Spillers, F. W. (to Dow Chemical Co.). US Patent 3,773,870. 20 Nov 1973. Filed date 13 Aug 1971. 4p.

A process is described for irradiating plastic tubing such that the dosage imparted to the tubing is uniform as to depth and area. The tubing is passed to a flattening zone, then to an irradiation zone, then reversed, inverted, and the sequence is repeated a plurality of times. The flattening zone comprises a flat roller or equivalent means. The irradiation zone comprises an electron beam gun or an equivalent irradiation source. The reversing and inverting is accomplished by a series of wheels and guide rollers arranged adjacent to the flat rollers. (Official Gazette)

10339 ISOTOPES AND IRRADIATORS (26 YEARS OF PROGRESS AT COMMERCIAL PRODUCTS). Hetherington, C. H. (Atomic Energy of Canada Ltd., Ottawa). pp vp of Proceedings of the 1972 annual conference of the Canadian Nuclear Association. Chalk River, Ont.; Atomic Energy of Canada Ltd. (1972).

From Canadian Nuclear Association 1972 annual conference; Ottawa, Ontario (11 Jun 1972). Paper No. 72-CNA-402.

The new computerized teletherapy system, introduced in the fall of 1971, is described. Details of the construction and method of use are outlined for large cobalt-60 sterilization plants. These plants are finding a continuously expanding application in the sterilization of medical disposables such as syringes, sutures, catheters and surgical packs. Specific plants used in Canada, the United States, New Zealand and other countries are illustrated. Gammacell and Gammabeam units are described, and a variety of their research uses is discussed. The low cost and ready availability of radioisotopes is illustrated and related to their many applications in research, medicine and industry. Information is provided on new Commercial Products products, including the Brachytron, for intercavitary therapy, Slowpoke, a small automatically controlled reactor, radioisotope power sources with applications in remote areas, an in-hospital sterilization plant and others. Areas of potential growth are examined and the economic aspects of the uses of radioisotopes and radiation are considered. (auth)

10340 POSSIBILITY OF RECOGNIZING IRRADIATED AND NONIRRADIATED POTATOES BY THEIR WEIGHT LOSS. Magaudda, G. (CNEN, Rome). J. Food Sci.; 38: No. 7, 1253-1254 (1973).

Tubers of potatoes were irradiated in an industrial irradiator facility (^{60}Co source) at total exposures of 0-5-7, 5-10-12, 5-15-20-40-80 Krads; stored 150 days at 10°C, 70% RH; and samples withdrawn periodically for weighing. Potato "cores" (60/sample variable) were analyzed at 2-day intervals over a 24-day storage period at RT. Calculated weight losses of treated and nontreated controls were used to plot the regression line and its angular coefficient b for each experimental lot. These data show a good relationship between weight loss and gamma ray exposure in the range applied for antisprouting purposes, especially for "core" potatoes. This analysis might be useful for recognizing "a posteriori" whether or not potatoes have been irradiated. (auth)

10341 USING RADIOACTIVE ISOTOPES FOR AEROSOL PARAMETER MEASUREMENTS. Bolotin, V. F. pp 138-143 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

The methods developed by various authors of tracing aerosols by the daughter emanation products were examined. An evaluation is given of the possibility of the practical use of these methods for the determination of the parameters of inactive aerosols by means of radioactive isotopes. (tr-auth)

10342 ELECTRON BEAM HARDENING: TODAY AND TOMORROW. Ottmann, G. (Herberts (K.) und Co., Lackfabriken, Wuppertal, Ger.). Farbe Lack; 79: No. 7, 633-638 (1973). (In German).

A critical analysis is made of the present technological development state of electron beam hardening with respect to former promising expectations. Using the results of comparing evaluations of electron beam hardenable and conventional resins and lacquers within the framework of actual coating purposes, the prospects of electron beam hardening in large-scale production are discussed. (GE)

10343 MODERN METHODS OF WEAR TESTING. Razim, C. VDI (Ver. Deut. Ing.) Ber.; No. 194, 33-43(1973). (In German).

Following a brief survey of the situation in the field of wear testing, a few physical test methods are described for studying wear mechanisms. The use of radioisotopes enables the observation of rapidly changing factors that influence wear and the identification of the wear partner in several components. X-ray fluorescence analysis, electron probes, and electron microscopy are also discussed. (GE)

10344 EFFECT OF SPRAY PARAMETERS ON FOOD CLEANING: POULTRY AS AN EXAMPLE. Hamza, A. A. R. A. Raleigh, NC; North Carolina State Univ. (1973). 129p. University Microfilms Order No. 73-29,547.

Thesis (Ph. D.).

A radioactive tracing technique was applied to evaluate the effect of spray parameters on water conservation and tagged E. coli removal during spray washing of poultry. Spray parameters investigated were: nozzle type and pressure, water amount and temperature, distance between nozzle and skin surface, and rotation of carcasses during spraying. (TFD)

10345 CALIFORNIUM-252 PROGRESS, NUMBER 15, MAY 1973. Californium-252 Progr.; No. 15, 1-49(May 1973).

Progress on the uses of ^{252}Cf is reported under the following topics: New York utilization meeting stimulates much participation; LSU Demonstration Center aids in nuclear education; Intelcom Demonstration Center to hold three-day course in neutron radiography; workshop on applications of ^{252}Cf to be held at LSU Demonstration Center; sales of ^{252}Cf; ^{252}Cf questions and answers; use of ^{252}Cf in nondestructive analysis for fluorine; radiotherapy; neutron radiography; natural resources exploration; process control; pollution control; neutron activation analysis; nondestructive analysis of solid propellant by fluorine determination; neutron detector efficiency studies; trace metal measurement system; high-speed fuel rod scanner; production of monoenergetic 6.129-MeV gamma rays for Ge(Li) detector calibration; prompt capture gamma ray measurements; and delayed-neutron logging for uranium with ^{252}Cf. (TFD)

LIFE SCIENCES

10346 (CEA-CONF-2266) RADIOBIOLOGICAL AND STANDARD DATA FOR RADIOPROTECTION AND RADIOTHERAPY. Jammet, H. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 5p. (In French). (CONF-720981-3). Dep. NTIS (U. S. Sales Only) $3.00.

From ninth annual meeting of the European Society for Radiation Biology; Rome, Italy (26 Sep 1972).

Radiobiological data provide the scientific bases for radioprotection norms and radiotherapy practices. Nevertheless numerous problems remain unsolved including dosimetry at the cellular and infracellular level, metabolic curves for the purification of radionuclides, dose-effect relations for stochastic phenomena, effect of high doses on conjunctive tissue, value of the calibration factor in time, RBE of high energy particles, and radiosensitivity as a function of age and sex. The scope of these problems is briefly indicated. (JSR)

Radiation Effects on Biochemicals

10347 (CEA-CONF-2235) INFLUENCE OF THE PRODUCTS OF RADIOLYSIS OF URACIL AND THYMIDINE ON THE BIOSYNTHESIS OF DNA OF EHRLICH'S ASCITES CELLS. Polverelli, M.; Teoule, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 5p. (In French). (CONF-720981-4). Dep. NTIS (U. S. Sales Only) $3.00.

From ninth annual meeting of the European Society for Radiation Biology; Rome, Italy (26 Sep 1972).

The effect of γ radiolysis products in aqueous solution of uracil and thymidine on the normal replicative biosynthesis of DNA of Ehrlich's ascites cells incubated in vitro in the presence of radioactive precursors of DNA (^{14}C-methyl thymidine or $^{14}C_2$-desoxyrytidine) was studied. The inhibiting effect of the thymidine radiolysis products, desoxy-2'-β-D-ribofuranosyl-1-hydroxy-5-methyl-5-barbituric acid and hydroxy-6-dihydro-5,6-thymidine, and the uracil radiolysis products, alloxanne and parabanic acid, was shown. (JSR)

10348 LACTIC DEHYDROGENASE IN THE TISSUES OF CERVICAL CANCER UNDER RADIATION THERAPY. Mizuno, Y. (Iwate Medical Coll., Morioka, Japan). Gan No Rinsho; 19: No. 3, 223-230(Mar 1973). (In Japanese).

Variation in the isozyme pattern of lactic dehydrogenase (LDH) in the tissues of cervical cancer under radiation therapy was studied on 23 cases. The LDH isozyme patterns were classified into three groups. The LDH was divided into I to V fractions. The group A (13 cases (56.5%)) showed a decline in the order of LDH I, II, III, IV, and LDH V, the group B (seven cases (30.4%)) had its peak in LDH II and the group C (three cases (13.0%)) in LDH III. Marked variation in the isozyme pattern under radiation therapy occurred only in the group A. The LDH I showed a decline along with the radiation dosage; on the contrary LDH III and LDH IV increased. The M/H ratio, LDH I/LDH II ratio, and LDH I/LDH III ratio also showed a decline in parallel with the above variation, shifting over to the hybrid type from M type. In the group B and C, little variation was observed. (auth)

10349 REPAIR OF ULTRAVIOLET-INDUCED DNA DAMAGE IN THE SUBCELLULAR SYSTEMS OF BACILLUS SUBTILIS. Shibata, T.; Saito, H. (Tokyo Univ.). Mutat. Res.; 20: No. 2, 159-173(Nov 1973).

Repair of uv-induced lesions in DNA was studied with various kinds of subcellular system prepared from Bacillus subtilis. The degree of repair during the post-irradiation incubation period was calculated from marker survivals in transforming DNA. Systems consisting mainly of non-viable spherical cells and subcellular fragments, as well as systems consisting of colony-forming protoplasts, were able to repair uv-induced lesions as efficiently as intact cell systems. A Teflon homogenate, a freeze-and-thawed product, and an osmotic shockate were also examined. The former two systems showed high repair activity, but the last did not. Attempts to repair the lesions with a supernatant fraction of Teflon homogenate were unsuccessful. In contrast with the active protoplast derivatives, toluene-treated cells were inert with respect to repair even when supplemented with substrates and cofactors although they retained DNA-synthesizing activity under similar conditions. (auth)

10350 INACTIVATION OF TRANSFORMING DNA BY ULTRAVIOLET LIGHT. I. Near-uv Action Spectrum for Marker Inactivation. Peak, M. J.; Peak, J. G.; Webb, R. B. (Argonne National Lab., IL). Mutat. Res.; 20: No. 2, 129-135(Nov 1973).

The kinetics of inactivation of the genetic activity of the leucine and tryptophan markers in purified Bacillus subtilis DNA by 254, 313, 334, 365, 405 and 460 nm wavelengths of uv light are described. At 254 and 313 nm, the DNA becomes increasingly resistant to inactivation with increasing dose, and the tryptophan marker is more sensitive than the leucine marker. However, at the longer wavelengths, the kinetics of inactivation are different, implying a different inactivation mechanism. For instance, there are shoulders at the longer wavelengths, and at lower doses the leucine marker is more sensitive than the tryptophan marker. Analysis by inverse square plots clearly distinguishes between far- and near-uv inactivation, revealing a greater tendency to exponential kinetics in the latter. An action spectrum reveals a component in the near uv that may indicate a different mechanism in this region. (auth)

10351 INACTIVATION OF TRANSFORMING DNA BY ULTRAVIOLET LIGHT. II. Protection by Histidine Against Near-uv Irradiation: Action Spectrum. Peak, M. J.; Peak, J. G.; Webb, R. B. (Argonne National Lab., IL). Mutat. Res.; 20: No. 2, 137-141(Nov 1973).

Histidine, at concentrations greater than 0.075 M, quenches the inhibition of the transforming activity of DNA by near uv. This effect does not occur at wavelengths below about 300 nm and is maximal at about 380 nm. Since histidine at this concentration has no effect upon the inactivation by far uv, this observation shows that inactivation by near uv is clearly different, and suggests an indirect photosensitization mechanism. The histidine protection spectrum coincides closely with the near-uv DNA inactivation spectrum derived from the shoulder in the near-uv. (auth)

10352 INACTIVATION OF TRANSFORMING DNA BY ULTRAVIOLET LIGHT. III. Further Observations on the Effects of 365 NM Radiation. Peak, M. J.; Peak, J. G.; Webb, R. B. (Argonne National Lab., IL). Mutat. Res.; 20: No. 2, 143-148(Nov 1973).

Several observations elucidating the mechanisms of inactivation of transforming DNA by 365 nm radiation are presented. 365 nm inactivation is sensitized by O_2. The effects of the uvr^- and uvr^+ genotypes on 254 and 365 nm inactivated DNA are compared. A large repair component is observed after 254 nm damage, and a small one after 365 nm. The two kinetics are different. 365 nm inactivation at two dose rates is compared. At 15,000 erg mm^{-2} sec^{-1} there is evidence for possible bleaching of a chromophore not evident at 7500 erg mm^{-2} sec^{-1}. 365 nm damage to regions of DNA not involved in complementary base pairing is likely, since DNA melting and annealing curves superimpose, comparing DNA inactivated to 1.0% of its genetic activity, and unirradiated DNA. This experiment obviates cross-linking as a major inactivating lesion. (auth)

10353 INITIAL EFFECT OF MOLECULAR RADIATION BIOLOGY. Yoshii, G. (Hokkaido Univ., Sapporo). Radioisotopes (Tokyo); 22: No. 4, 204-214(Apr 1973). (In Japanese).

This is the typical presentation of the course in which molecules absorb the energy of radiation and, through complicated time-course phenomena, are led to visible biologic death, or to exerting genetic effect. They go through physical, physicochemical, chemical, and biologic stages. Various phenomena in the stages prior to the biologic one as the initial process of the effect of molecular radiation biology are reviewed. First, in the physical process, energy is absorbed by substances where ionized and excited molecules are formed. Second, in the physicochemical process, the ionized and excited molecules formed in molecules form molecular radicals due to rearrangement and intramolecular and intermolecular transfers of energy. As the study of nonaqueous molecular radicals, the results of studies of DNA not containing water and its constituent molecules by means of ESR were summarized. As the study of the formation of molecular radicals in aqueous solution, the results of studies of the initial reaction of OH^*, H^*, e_{aq}^- with the constituent molecules of nucleic acids by means of pulse radiolysis were summarized. For the purpose of elucidating the mechanism of radiation protection and intensification, the results of observation by the ESR method of the reaction produced by pulse radiolysis and model experiments were described. As the molecular alteration following radical formation, alterations of the base and sugar, severance of polynucleotide chains, and disruption and the three-dimensional structure of hydrogen bonding were described. As the effect of radiation on the biologic activity of nucleic acids, i.e., inactivation, the kinetics of each of infectivity, transformation, priming activity of DNA, and translation was referred to. (JA)

10354 STUDY OF THE TEMPLATE PROPERTIES OF CHROMATIN FOR DNA POLYMERASE I AND OF THE EFFECTS OF IONIZING RADIATION. Itzhaki, R. F.; Saffhill, R. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Eur. J. Biochem.; 35: No. 2, 259-265(1973).

The template activity of rat thymus chromatin for Escherichia coli DNA polymerase I was found to amount to only 6% of that of pure DNA. Assays were carried out on chromatin in 0.05 M NaCl, on a chromatin-polylysine complex, on the soluble and insoluble fractions of chromatin in the assay system and on DNA prepared from chromatin. The results suggest that the low activity is due only to a small extent to the insolubility of the chromatin in the assay system. Instead, it is proposed that initiation is restricted to certain accessible DNA zones in chromatin. After γ irradiation of the chromatin, the template activity increases with increasing dose up to a certain level and then decreases. It is therefore proposed that both active and inactive binding sites for DNA polymerase are formed on irradiation. Assays on a chromatin-polylysine complex indicate that the new initation sites occur in the accessible zones. (GE)

Radiation Effects on Cells

Refer also to abstracts 10450 and 10462.

10355 DNA REPAIR CAPACITY AND SUSCEPTIBILITY TO CHROMOSOME BREAKAGE IN XERODERMA PIGMENTOSUM CELLS. Sasaki, M. S. (Tokyo Medical and Dental Univ.). Mutat. Res.; 20: No. 2, 291-293(Nov 1973).

Semi-whole blood microcultures were prepared from venous blood of a XP patient and from the blood of a normal adult. Cells were collected by centrifugation and treated with MMS or 4 NQO in a medium containing ^{3}H-thymidine. With regard to the repair capacity of the XP cells, the levels of unscheduled incorporation of ^{3}H-thymidine into cultured skin fibroblasts were less than 1% after 254-nm uv irradiation, about 5% after 4 NQO treatment, and 100% after MMS treatment as compared to control levels. With regard to the mechanisms by which specific agents produce chromosome aberrations, results show the importance of damage to DNA and its repair on the production of chromosome aberrations by 4 NQO. (HLW)

Radiation Effects on Microorganisms

Refer also to abstract 10349.

10356 (CEA-CONF-2279) EVALUATION OF THE TOXICOLOGY OF IRRADIATED MAIZE STARCH: SUMMARY OF RESEARCH COMPLETED. Saint-Lebe, L.; Berger, G.; Mucchielli, A.; Coquet, B. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'etudes Nucleaires). [nd]. 15p. (In French). (CONF-721101-3; SM-166/7). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972).

The evaluation of the toxicity of irradiated corn starch was undertaken in three areas: animal studies, identification and determination of radiolysis products, and study of the toxicity of radiolysis products for micororganisms. In the animal studies rats were fed raw and cooked starch irradiated at 300 and 600 krad and the effects on weight gain and reproduction were determined. No toxic effects attributable to irradiation were detected. In the identification of radiolysis products, aldehydes, sugars, and acids as well as hydrogen peroxide were detected, but they were present in very small quantity. A test for irradiation of starch based on the determination of malonic aldehyde was developed. A lethal effect was detected in cultures of Escherichia coli in media rich in irradiated starch extract. It was attributed in large part to hydroxyalkyperoxides formed during the irradiation. (JSR)

10357 (CEA-CONF-2280) PRELIMINARY STUDIES ON THE MICROFLORA OF MAIZE STARCH BEFORE AND AFTER IRRADIATION. Saint-Lebe, L.; Mucchielli, A.; Leroy, P.; Beerens, H. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). [nd]. 8p. (In French). (CONF-721101-4; SM-166/6). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on radiation preservation of food; Bombay, India (13 Nov 1972).

Powdered corn starch is used in the preparation of many foods and it must be free of pathogenic bacteria and fungi and their spores. The purity norms established for starch are summarized. The nature of the possible pollution is described. Starch samples heavily polluted with spores were γ irradiated at different doses. A dose of 150 krad destroyed approximately 95% of the aerobic bacteria and fungi. Spores of Clostridium disappeared completely at 300 krad and only 8 percent remained at 200 krad. Spores of aerobic bacteria, thermally pretreated, were reduced 95% at 200 krad, but 10 percent of the aerobic bacteria remained at this dose. These results were confirmed by similar tests with potato starch. (JSR)

10358 (UR-3055-8) NONSENSE SUPPRESSION IN YEAST. Liebman, S. W. (Rochester Univ., N. Y. (USA)). 1973. Contract AT(11-1)-3055. 245p. Dep. NTIS $14.25.

Thesis.

Nonsense suppressors in yeast were studied with the aid of the iso-1-cytochrome c genetic system and x-ray induced mitotic recombination. One aim was to uncover amber suppressors which act with high efficiencies and to determine the amino acid residue that each suppressor inserts. (CH)

10359 EFFECT OF THE COMBINED ACTION OF γ RAYS AND ETHYLENIMINE ON DRY CREPIS CAPILLARIS SEEDS. Sidorov, V. P. (Inst. of Genetics, Moscow). Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 153-155(Oct 1973). (In Russian).

The effect of the combined action of γ rays and ethylenimine (EI) in G_1 stage was studied on the model of dry Crepis capillaris seeds in two successive cell divisions. As a result of the combined action of γ rays at the dose 2 kR and ethylenimine at the concentration of $4.6 \cdot 10^{-3}$ M in diploid metaphases lower additive effect was obtained. The effect of the combined action of γ rays (2 kR) and EI ($9.3 \cdot 10^{-3}$ M) during the first cell division is additive, and it is over-additive when seeds are treated with γ rays at dose 2 kR and EI at the concentration of $2.3 \cdot 10^{-2}$ M, and respectively, γ rays at dose 10 kR and EI at concentration of $9.3 \cdot 10^{-3}$ M. (auth)

10360 LETHAL EFFECT OF UV AND γ IRRADIATION ON SOME SPECIES OF DEMATIACEAE. Zhdanova, N. N.; Gavryushina, A. I.; Bondar, A. I. (Inst. of Microbiology and Virusology, Alma Ata, USSR). Mikrobiol. Zh.; 34: No. 2, 173-177(1972). (In Russian).

A comparative study was conducted of relation of four species of Dematiaceae and a mutant with lowered content of melanine to γ and uv rays. Under uv irradiation, survival rate of all studied species was characterized by a complex exponential curve with a large, sharply pronounced resistant area. An assumption is advanced that a sharp fall of survival rate during the first minutes of uv irradiation is conditioned by specificity of the protective effect of melanine pigment that needs time for transition into the active state. Species resistant to γ irradiation had sygmoid curves of survival rate and sensitive species had the exponential ones. Increased resistance to γ rays was accompanied by an increase in concentration of paramagnetic-particles that were determined by the method of electronic paramagnetic resonance. Analysis of the data obtained makes it possible to suppose that the protective effect of fungal melanine is various under γ and uv irradiation. (auth)

10361 ANALYSIS OF MINIMAL FUNCTIONS OF SIMIAN VIRUS 40. II. Evidence for Host Cell Repair of Oncogenicity and Infectivity of Uv-Irradiated Simian Virus 40. Seemayer, N. H.; Defendi, V. (Wistar Inst., Philadelphia). J. Virol.; 13: No. 1, 36-41(Jan 1974).

The in vitro transforming capacity of simian virus 40 (SV40) for Syrian hamster cells is highly resistant to inactivation by uv light in comparison to infectivity. In the same cell system, a host cell repair mechanism sensitive to caffeine was demonstrated, which is, to a large extent, responsible for the high resistance to uv inactivation of the transforming capacity of SV40. The survival of infectivity of uv-irradiated SV40 in CV-1 cells was also sensitive to caffeine, again indicating host cell repair. On the other hand, depression of normal cell DNA synthesis by hydroxyurea during the first 24 h postinfection only modestly reduced, and to a similar extent, the transforming capacity of uv-irradiated and nonirradiated SV40. (auth)

10362 BIOCHEMICAL STUDIES ON THE X MUTATION OF BACTERIOPHAGE T4: DIFFERENTIAL INHIBITION OF x^+ AND x DNA SYNTHESIS BY MITOMYCIN C. Shimizu, K.; Sekiguchi, M. (Kyushu Univ., Fukuoka). J. Virol.; 13: No. 1, 1-8(Jan 1974).

Biochemical studies were carried out to determine the effect of x mutation on T4 DNA synthesis. The rate and final extent of DNA synthesis are almost the same with T4D- and T4x-infected cells, although the burst size of T4x is about one-sixth that of the wild type. The DNA synthesis of T4x-infected cells is more readily inhibited by mitomycin C than is that of T4 wild type. When mitomycin C was added during active phage growth, DNA synthesis of T4x halted almost immediately. T4 DNA polymerases isolated from x^+- and x-infected cells, however, exhibit no difference with regard to their sensitivities to mitomycin C, priming activities with alkylated or ultraviolet light-irradiated templates and other enzymatic properties. (auth)

10363 ULTRAVIOLET LIGHT-INDUCED RECOMBINATION. Helling, R. B. (Univ. of Michigan, Ann Arbor). Biochem. Biophys. Res. Commun.; 55: No. 3, 752-757(10 Dec 1973).

Stimulation of transduction in Escherichia coli by ultraviolet irradiation of the transducing phage P1 requires the uvrA-uvrB nuclease but not the uvrC product or DNA polymerase I. It is hypothesized that the first step in normal recombination can be bypassed by any procedure generating single-stranded ends of DNA (as, for example, by uvrA-uvrB nuclease activity). (auth)

10364 USE OF γ IRRADIATION TO PREVENT AFLATOXIN PRODUCTION IN BREAD. Bullerman, L. B.; Barnhart, H. M.; Hartung, T. E. (Univ. of Nebraska, Lincoln). J. Food Sci.; 38: No. 7, 1238-1240(1973).

Irradiation doses of 100 and 200 Krad reduced the growth of Aspergillus parasiticus in bread stored for 10 days at 25°C. With bread stored longer than 2 wk, mold growth in irradiated samples tended to approach the amount which occurred in the non-irradiated controls. Mold strain NRRL 3000 seemed slightly more sensitive to irradiation than strain NRRL 2999. A 200 Krad dose prevented aflatoxin production by either strain at both high and low levels of inoculation with spores in bread stored for 10 days, except in one case where a very low level of aflatoxins was detected. At 100 Krad, bread inoculated with 10^2 spores/slice contained none to low concentrations of aflatoxins after storage for 10 days, but with 10^6 spores/slice higher amounts of toxins were detected. When the inoculated bread was stored for periods up to 6 wk, the 200 Krad treatment prevented aflatoxin production in all bread samples containing 10^2 spores/slice, and in almost all samples containing 10^6 spores/slice. The 100 Krad treatment also prevented aflatoxin production during 6 wk of storage in bread that contained 10^2 spores/slice. However, with 10^6 spores/slice both strains were capable of producing very high amounts of aflatoxins after irradiation at 100 Krad. At 1, 2 and 6 wk of storage, these amounts were greater than the unirradiated controls, suggesting possible stimulation of aflatoxin production. (auth)

10365 FORMATION OF PURE AND MIXED CLONES OF C MUTANTS IN SERRATIAPHAGE SIGMA (SIGMA) AFTER TREATMENT OF THE FREE VIRION WITH UV OR HYDROXYLAMINE. Pons, F. W. (Univ., Frankfurt am Main). Mutat. Res.; 20: No. 2, 149-157(Nov 1973).

The clone composition of c mutants of phage σ induced by uv irradiation of the free virion was studied, using Hcr^+, Hcr^- and uv-irradiated Hcr^+ cells as hosts and 2, 3, and 4 different uv doses, respectively. Most of the c plaques contained only mutant phages, and the distribution of mosaics was asymmetrical, i.e. most mixed clones contained >80% mutant type. The frequency of mosaics decreased with increasing uv dose in all three host systems; however, the decrease was significant only with the uv-irradiated Hcr^+ host. Propagation of uv-irradiated σ in Hcr^+ and Hcr^- hosts, respectively, did not lead to a significant difference in the frequency of mosaics, but, using uv-irradiated Hcr^+ host significantly increased the percentage of mixed clones. The composition of plaques containing c mutants, after uv irradiation and treatment with hydroxylamine, was also studied by picking and testing all plaques (mutant and wild-type) of the survivors of a single uv dose and a single incubation time, respectively. In both experiments, besides pure and nearly pure (visible) c mutant plaques, many cryptic mutants containing predominantly >20% mutant type were found. The distribution of mosaics was of an almost inverse symmetrical type, the class of clones with about 50% mutant and 50% wild-type being the rarest. From these results incomplete recombinational repair is suggested to be responsible for the formation of pure mutant clones in mutation induction. (auth)

10366 ISOLATION AND SURVIVAL CHARACTERIZATION OF RADIATION AND CHEMICAL-MUTAGEN SENSITIVE MUTANTS OF PSEUDOMONAS AERUGINOSA. Kung, A. H. C.; Lee, B. T. O. (Univ. of Melbourne). Mutat. Res.; 20: No. 2, 175-190(Nov 1973).

Using a variety of selection techniques, 52 radiation- and chemical mutagen-sensitive mutants have been isolated from Pseudomonas aeruginosa. These mutants have been phenotypically characterized and appear to constitute 12 groups separable on the basis of their survival responses and phage reactivation ability. The majority of the mutants are sensitive to uv radiation and/or methyl methanesulfonate (MMS). There appears to be cross sensitivity between MMS and nitrosoguanidine (NTG), but not between either of these and γ radiation. The presence of host-cell reactivation deficient mutants for phages treated with uv light or MMS suggests that the lesions induced by these can be repaired to some extent in the parent strain, whereas the lack of host-cell reactivation (HCR) for γ-irradiated phages could mean that there is no repair of this type of damage. Four classes of mutant that do not yet have their parallels among the radiation-sensitive mutants of other bacterial species are reported. (auth)

10367 PHYSICOCHEMICAL STUDIES OF EQUINE INFECTIOUS ANEMIA VIRUS. V. Effect of Ultraviolet Irradiation on Virus Infectivity. Nakajima, H.; Mizuno, Y.; Yasuda, K.; Ushimi, C. (National Inst. of Animal Health, Tokyo). Arch. Gesam. Virusforsch.; 41: 135-137(1973).

The effect of ultraviolet radiation on the infectivity of equine infectious anemia (EIA) virus is described using influenza virus and Rous sarcoma (RSV) virus as controls. Virus preparations were placed in Petri dishes and uv-irradiated by a 15 watt germicidal lamp. At intervals up to 30 min samples were taken to determine the infectivity in surviving fractions. The infectivity of the influenza virus was reduced by four orders about 2 min after irradiation; the EIA virus infectivity was reduced to the same extent in 20 min, and the RSV infectivity was reduced to the same extent in 30 min. (HLW)

10368 STUDY OF PASTEURELLA TULARENSIS TOXICITY FOLLOWING THE ACTION OF IONIZING RADIATION. Meshcheriakova, I. S. (Inst. of Epidemiology and Microbiology, Moscow). Zh. Mikrobiol., Epidemiol. Immunobiol.; 50: 43-47(Mar 1973). (In Russian).

Experiments were performed on albino mice; Pasteurella tularensis killed by irradiation proved to be toxic. The toxic component of P. tularensis proved to be labile and lost its activity on storage of the microbial suspension. Immune serum produced an antitoxic effect and saved the animals to which irradiated suspensions of P. tularensis were administered from death. An association between the toxic action and the virulence of the strain used was shown. Administration of irradiated suspensions protected individual mice to which lethal doses of the causative agent were administered from death. Immunogenic action was expressed only in prolongation of survival of experimental animals by comparison with control. (auth)

10369 CONTENT OF FREE NUCLEOTIDES IN AUTOLYZING MUSCLES OF FISH DURING IRRADIATION. Klyashtorin, L. B. (All Union Research Inst. of Fishery and Oceanography, Moscow). Prikl. Biokhim. Mikrobiol.; 9: No. 1, 86-90(1973). (In Russian).

The pattern of inosine monophosphate (IMP) decay and accumulation of nucleosides and nitrogen bases in the muscular tissues of fish exposed to ^{60}Co gamma irradiation with a dose of 400 krad at a dose rate of 500 krad/hr was studied. Extracts of tissue homogenates treated with 0.6 M $HClO_4$ were fractionated on Dovex 1 × 8 columns. Nucleosides were identified with respect to their absorption spectra and the sequence of their release (according to the literature data). Pasteurizing dosages of irradiation (400 krad) did not affect the decay of adenyl nucleotides in the fish muscular tissue. The IMP decay in the carp tissue was completed for 12 days at the storage temperature of 0 to +2°C and for 6 to 7 days at the storage temperature of +5°C. The muscular tissue always contained a certain amount of AMP that was not involved in the decay of nucleosides. (auth)

10370 PRESENT STATUS AND PROBLEMS OF FOOD IRRADIATION. Special Reference to Radiation Source Engineering. Tanaka, Y. (Kawasaki Heavy Industries Ltd., Kobe, Japan). FAPIG (Tokyo); No. 67, 198-204(Nov 1972). (In Japanese).

In order to establish the economy of equipment for a food irradiation treatment plant, the most suitable conditions including radiation source irradiation system, physical flow system of irradiation matter, and automatic transportation system were discussed. The relationship especially between problems on radiation source engineering (radiation source, irradiated matter, irradiation technique, shielding, and radiation detection), and physical transportation flow system and apparatus was described in the case of potato irradiation. The radiation sources were mainly ^{60}Co and ^{137}Cs, and a pellet or a disk is generally suitable. Limitation conditions necessary for transportation of the radiation source must be considered in planning of radiation source elements. The maximum or the minimum value of exposure dose is determined with regard to radiation effects and safety on foods. Build-up factors and radiation index decline are regulated according to the size of the irradiation matter. The ratio of the distance between radiation source and the container to the length of radiation source must be constant to obtain the uniformed utility efficiency of the radiation source, and the transportation system should be regarded for obtaining the most suitable conditions. Shielding materials and their necessary amounts are determined taking into consideration the irradiation device, irradiation room, and the size of the irradiation. The irradiation equipment system is composed of the radiation source and radiation source running gear and safety equipment for radiation protection. The arrangement of the radiation field, countermeasures against radiation, and safety standards should be established considering the above-mentioned conditions. (JA)

10371 RADIOSTERILIZATION OF MEDICAL PRODUCTS. 4. Effects of Gamma Radiation on Physical and Chemical

Properties of Disposable Infusion Assemblies. Oba, T.; Horibe, T.; Kikuchi, H.; Mori, J. (National Inst. of Hygienic Sciences, Tokyo). Eisei Shikenjo Hokoku; No. 90, 15-20(Nov 1972). (In Japanese).

Disposable infusion assemblies were irradiated with ^{60}Co γ rays at 5 levels (0, 1.0, 2.5, 4.5, and 10 Mrad). The effects of γ radiation on the physical and chemical properties of the infusion assemblies were investigated. They were slightly affected by irradiation on some physical properties, maximum breaking load and elongation. However, some samples showed inferior quality at 4.5 and 10 Mrad. Some polyvinylchloride tubes colored to light yellow or light brown color. In general, the samples showed a tendency to a decrease of pH and an increase of reducing substances and heavy metals dissolved in its eluted solution, when they were irradiated above 4.5 Mrad. (auth)

10372 BIOLOGICAL INDICATORS FOR RADIOSTERILIZATION. Kato, T. (Radiation Center of Osaka Prefecture). Genshiryoku Kogyo; 19: No. 2, 45-48(Feb 1973). (In Japanese).

Conventional biological indicators for radiosterilization are qualitative and sometimes show signs of sterilization even when the degree of sterilization is not satisfactory. Therefore, there is a possibility that the effectiveness of sterilization is mistaken. Quantitative biological indicators in which a certain amount of indicated bacteria survive under a given amount of sterilization were proposed. Soluble polyvinyl alcohol (PVA) was chosen as a support. In addition, two types of strip for biological indicators were prepared: one 2 cm in length, 1 cm in width, 30 μ in thickness, and containing 10^9 of bacteria, and the other one is the accumulated strip consisting of 10 of the above mentioned strips and containing 10^{10} of bacteria. In addition, theoretically it is considered to be necessary to maintain about 10^{15} bacteria. Therefore, pill-type indicators 2 cm in diameter, 0.5 cm in thickness, and containing 10^{13} bacteria were also prepared. The PVA (with protective action on radiation) was added as a combined drug. Prepared indicators were irradiated with 0.3 Mrad/hr. of α-rays from ^{60}Co. The D value (lethal dose of 90% bacteria) in the strip type, the accumulated strip type, and the pill type showed 0.3, 0.29, and 0.18 Mrad, respectively. In the irradiation of 2.5 Mrad, the number of living bacteria was $10^{0.7}$ in the strip type, $10^{1.4}$ in the accumulated strip type, and 0 in the pill type. In the combination of biological and chemical indicators the effectiveness of indicators was compared in two cases when both indicators were merely arranged and when the organic contribution of both indicators was performed. Further study should be done on the development of both methods. (JA)

10373 SECONDARY EFFECTS OF STERILIZATION OF THE RIFAMPICIN BY GAMMA IRRADIATION. Crippa, P. R.; Tedeschi, R.; Vecli, A. (Univ., Parma, Italy). Farmaco (Pavia) Ed. Prat.; 28: No. 4, 226-232(Apr 1973).

The effects of gamma radiation at sterilizing doses on the rifampicin were studied by several physical and chemical techniques. In particular, the ESR results suggest a negligible effect and confirm the possibility of using this type of treatment for sterilizing rifampicin. (auth)

10374 ENERGY METABOLISM AND REPAIR OF UV DAMAGE IN SACCHAROMYCES. I. The Effect of Glucose on Recovery of uv-Sensitive Mutants. Schaarschmidt, B.; Umlauf, C.; Lamprecht, I. (Freie Univ., Berlin). Int. J. Radiat. Biol.; 24: No. 5, 433-441(Nov 1973).

Liquid-holding recovery in Saccharomyces was found to depend on glucose concentration during pre-ultraviolet irradiation treatment or during the liquid-holding period in the wild type and in mutant strains $r_1^s r_1^s$, $r_2^s r_2^s$, and $r_{3-2}^s r_{3-2}^s$. The maximum glucose enhancement effect on survival was about 15% in wild-type, 40% in $r_1^s r_1^s$, 20% in $r_2^s r_2^s$, and 3% in $r_{3-2}^s r_{3-2}^s$ mutants at a buffer concentration 4×10^{-10} g glucose per cell. Concentrations greater than 10^{-7} glucose per cell cause a decreasing effect on liquid-holding recovery. The results are discussed in view of different energy pathways and the lack of repair capacities in the strains used. (auth)

Radiation Effects on Plants

Refer also to abstract 10340.

10375 (IAEA-R-1036-F) USE OF ISOTOPES AND RADIATION IN BREEDING OF HIGH-PROTEIN RICE. Part of a Coordinated Programme on the Use of Nuclear Techniques for Seed Protein Improvement. Final Report for the Period 1 July 1971-30 June 1972. Chu, Y. E.; Li, Y. S.; Tsai, K. S.; Wu, S. C. (International Atomic Energy Agency, Vienna (Austria)). Aug 1972. vp. INIS.

The induction of high protein content in rice, (Chianung 242, a japonica variety grown in Taiwan) was attempted by irradiating seeds with doses of 20, 25, 30, 40, and 50 Kr γ rays. A total of 2,121 M_2 plants were grown and analyzed for variation in protein content. Plants from irradiated seeds showed on the average lower protein content (0.5 to 1.0%) than the original Chianung 242 variety, except for the population of high sterility mutants, which showed a higher protein content. The standard deviation for protein content was larger in the mutant population of plants than for the original non-irradiated population; at higher γ doses the standard deviation in protein content was larger. The distribution of protein in individual grains of rice and the variation of protein distribution patterns among varieties were also studied. (INIS)

10376 (INIS-mf-458) INFLUENCE OF GAMMA IRRADIATION ON THE FORMATION OF AROMATIC COMPONENTS IN FRUIT. Tobback, P. (Institut Belge de l'Alimentation et de la Nutrition "Iban," Brussels). 1972. 17p. (In Dutch). INIS.

Studies on the influence of gamma radiation on the formation of aromatic components in apples showed that the formation was reduced with doses above 200 krad. Effects on ripening are dependent on the temperature of preservation. (INIS)

10377 (ORO-2583-11) CYTOLOGICAL STUDY OF RADIATION INDUCED ALTERATIONS IN CYTOPLASMIC FACTORS CONTROLLING MALE STERILITY IN CORN. Progress Report, February 28, 1973-December 1, 1973. Edwardson, J. R. (Florida Univ., Gainesville (USA). Dept. of Agronomy). 1973. Contract AT(40-1)-2583. 20p. Dep. NTIS $3.00.

Cytoplasmic male sterile accessions, other than T-type, are being backcrossed to adapted maintainer and restorer inbred corn lines. Fertile selections from γ-irradiated T-type corn continue to exhibit resistance to infection by race-T of Helminthosporium maydis in field and greenhouse tests. Cytological comparisons of these fertile selections and T-sterile, maintainer, and restorer lines are continuing. Dominant male sterility and its suppression in S-cytoplasm corn is being investigated. Induction of cytoplasmic male sterility in normal cytoplasm corn and suppression of susceptibility to Helminthosporium maydis infection in T cytoplasm corn is being attempted with chemical mutagens. Consistent differences in cytoplasmic inclusions in sterile and maintainer Vicia faba were observed. Consistent differences in mitochondria were observed in cytological comparisons of normal and sterile corn. These abnormal mitochondria and non-Mendelian plastid abnormalities in corn, sorghum, tobacco, and petunia will be used in studying the fertilization process. Investigations of the properties of Datura Q-virus are near completion. Cytological and serological studies indicate the Q-virus is a strain of tobacco streak virus. Graft-transmission of cytoplasmic male sterility is being attempted in sunflower. (auth)

10378 (ORO-2583-12) [CYTOLOGICAL STUDY OF RADIATION INDUCED ALTERATIONS IN CYTOPLASMIC FACTORS CONTROLLING MALE STERILITY]. Progress Report, 1971-1973. (Florida Univ., Gainesville (USA). Dept. of Agronomy). 1973. Contract AT(40-1)-2583. 18p. Dep. NTIS $3.00.

Progress is reported on studies of cytoplasmic factors controlling male sterility in plants. Results are reported from cytological comparisons of fertile selections from γ-irradiated corn with male steriles, mainliners, and restored steriles, in which no consistent differences in cytoplasmic constituents were observed. Results of cytological and genetic studies on mutants of Neurospora crassa, petunia, tobacco, sorghum, sugar beets, Vicia faba, and several gymnosperms are summarized. The relationship between male sterility of plants and their susceptibility to virus and fungus infections was also studied. (CH)

10379 (ORNL-TM-3837) FINAL REPORT ON POSTATTACK ECOLOGY. Auerbach, S. I.; Dunaway, P. B.; Dahlman, R. C. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 83p. Dep. NTIS $6.25.

Data are summarized from studies on the behavior of ^{137}Cs fallout simulant on fescue grass and cotton rats in natural systems; transfers of ^{137}Cs through soils, plants, and animals; retention of ^{54}Mn and ^{60}Co in pine voles; γ and β dosimetry; and effects of chronic and acute β and γ radiation exposures at various doses and dose rates on fescue plants and on cotton rats, white-footed mice, and soil arthropods (collembola) in the laboratory and in the field. (CH)

10380 EFFECT OF GAMMA RADIATION ON THE LIPIDS OF PEANUTS AND WALNUTS. I. Bancher, E.; Washuettl, J.; Goller, H. J. (Technische Hochschule, Vienna). Seifen-Oele-Fette-Wachse; 98: No. 16, 505-507(1972). (In German).

The composition of the polar lipids (lecithin, colaminecephalin, and phosphatides) was investigated by means of various types of thin-layer chromatography, such as the so-called

garland technique, as well as densitometric and colorimetric methods. Whereas the effect of irradiation with a low dose of 0.5 mrad was negligible, considerable radiation-induced changes in the composition of the polar lipids were found after irradiation with a dose of 10 mrad. This effect proved to be stronger in walnuts. The decomposition of the lipids is explained by two reaction mechanisms that are assumed to proceed via the formation of radicals to the formation of phophatidic acid, or lysolecithin and lysocephalin, respectively. (GE)

10381 EFFECT OF GAMMA IRRADIATION OF THE SEEDS ON THE ACCUMULATION OF POTATO X-VIRUS IN SOME PLANTS. Anokhin, V. M. (Inst. of Microbiology and Virusology, Alma-Ata, USSR). Mikrobiol. Zh.; 33: No. 3, 353-358 (1972). (In Russian).

Pre-seeding γ irradiation of Solanum L., Datura L., and Gomphrena L. seeds with a dose of 1000 rad and intensity of 660 rad/min does not affect development of the plants, accumulation of potato X-virus in them, and manifestation of the disease symptoms. Irradiation of seeds with a dose of 4000 and especially of 16,000 rad evoked heavy radiation injuries in vegetating plants, favored rapid and great accumulation of the virus and a more pronounced manifestation of the disease symptoms. An increase in sensitivity of plants grown from seeds irradiated by γ rays with doses of 4000 and 16,000 rad to viral infection, might be connected with disturbances in the metabolic processes and antiviral protective reactions. (auth)

10382 POLYPHENOL OXIDASE ACTIVITY AND BROWNING OF MANGO FRUITS INDUCED BY GAMMA IRRADIATION. Thomas, P.; Janave, M. T. (Bhabha Atomic Research Centre, Bombay). J. Food Sci.; 38: No. 7, 1149-1152(1973).

Mangoes were gamma-irradiated at a dose rate of 4 Krad per min in doses of 15 to 200 Krad. Methods are described for extraction of the enzyme, assay of enzyme activity, and estimation of total phenolic constituents, ascorbic acid, and pH. Above doses of 75 Krad discoloration increased with dose and longer storage periods. An increase in activity of polyphenol oxidase was found with increasing radiation doses; a several-fold increase was observed at 200 Krad. This increase was correlated with external manifestations of radiation injury. Possible ways in which the activation of polyphenol oxidase in mango fruits is brought about by irradiation are discussed. (HLW)

10383 IN VITRO SYNTHESIS OF A SPECIFIC PROTEIN VIZ. ASPARAGINE SYNTHETASE BY NUCLEAR FRACTION FROM GAMMA IRRADIATED POTATO BUDS. Nair, P. M.; Shirsat, S. G. (Bhabha Atomic Research Centre, Trombay, India). Biochem. Biophys. Res. Commun.; 55: No. 3, 588-594 (10 Dec 1973).

Irradiation induced synthesis of asparagine synthetase was localized in the nucleus of the potato buds. Isolated nuclei were capable of incorporating amino acids into asparagine synthetase protein and the process was inhibited by cycloheximide (100%), puromycin (73%) and by feed back inhibitor β-aspartyl hydroxamate (100%). Preincubation of the bud tissue with actinomycin D was necessary to express its inhibitory effect. (auth)

10384 SOMATIC INTERPHASE PAIRING OF VICIA CHROMOSOMES AS INFERRED FROM THE HOM/HET RATIO OF INDUCED CHROMATID INTERCHANGES. Riegler, R.; Michaelis, A.; Schubert, I.; Meister, A. (Zentralinstitut fuer Genetik und Kultupflanzenforschung, Gatersleben, Ger.). Mutat. Res.; 20: No. 2, 295-298(Nov 1973).

Chromatid interchanges were induced in Vicia faba root-tip meristems with chemical mutagens and x radiation. The ratio of homologous to heterologous chromatid interchanges showed that those between homologues were significantly more frequent than expected for random involvement of individual chromosomes. The data indicate that V. faba chromosomes are somatically paired during those parts of interphase when induced chromatid interchanges become realized. (HLW)

10385 EFFECTS OF HIGH ALTITUDE COSMIC RADIATION ON SOME MEMBERS OF ACANTHACEAE. Kaur, J.; Nizam, J. (Osmania Univ., Hyderabad, India). BPABA; 14: No. 6, 406-413 (1972).

To study the effect of high-altitude cosmic radiation the seed material of 15 species of Acanthaceae was subjected to three types of exposure in balloon flights at an altitude of 30,900 to 38,100 metres. Germination behavior was recorded and cytological studies were made. In the material subjected to one exposure, no detectable cytological or morphological changes were recorded. The material subjected to two exposures showed a $1\frac{1}{2}$- to 2-fold increase in cellular dimensions. A fragmented chromosome was observed in Rostelluralia procumbens. Flowering in Justicia betonica was advanced by 3 weeks. Among the species subjected to three exposures, two species showed a diminution in height and began flowering earlier than the controls. A study of germination behavior showed, in general, that a decrease in germination percentage was directly proportional to the radiation dose. The results indicate that treatment with cosmic radiation can be helpful in reducing the period between sowing and harvesting. Therefore, if similar experiments were conducted on crop plants, they could, from the agricultural point of view, yield interesting and important results. (Nucl. Sci. Abstr. Czech.)

10386 EFFECT OF HEAVY WATER (D_2O) ON ROOT MERISTEMS OF SECALE CEREALE L. Sil'chenko, V. V. (Inst. of Plant Physiology, Kiev). Dokl. Akad. Nauk SSSR; 211: No. 4, 963-965(1 Aug 1973). (In Russian).

With rye seeds, grown on a medium in which 5 to 99.8% of its water was present as D_2O, more than 10% D_2O was toxic. The inhibiting action on the cell led to an increase in the dimensions of both the cell and the nucleus. The cytoplasm and nucleus were both damaged, and cells of the dermatogen and periblem showed a high vacuolization. Chromosome aberrations were increased by the heavy water, the transition from prophase to metaphase was inhibited, and DNA and RNA synthesis were inhibited. (auth)

10387 FUTURE STATUS OF RADIATION BREEDING. Tanaka, S. (National Inst. of Agricultural Sciences, Tokyo). Kagaku Kogyo; 24: No. 3, 354-359(Mar 1973). (In Japanese).

The induction of artifical mutations by radiation and its utilization for radiation breeding are discussed. There are external and internal irradiation methods to induce mutations by radiation. The former method has the advantage of good reproducibility and occupies the main current. In the latter method, the rate of mutation per rate of dose unit is high and nuclides used for this method were radioactive phosphorus, sulfur, and calcium. Mutation induction effect of irradiation on cells in the stage of cell division was four times higher than in resting cells, and recently cases of irradiation to reproduced cells under the condition controlling growth environment for plants have been increasing. In utilization of variations in spermatophytes, there are direct utilization of variations as excellent breedings and indirect utilization in which a new breeding is reared by using a variation as the mating nucleus. As for breedings which have a good harvest, hereditary analysis of factor of stabilizing production (precocity, and features of disease resistance, fall-resistance, and cold- and heat-resistance) advances. Besides, improvement of ingredients (improvement of seed protein and elimination of poisonous ingredients), simplification of harvest work by dwarfism and one generation crossbred seed and utilization of variation in mating of distant relations were described. Disorganization of chimera is important for utilization of somatic cell mutations. As its study case, utilization of unstable buds and resting buds, that of compensation of growing point cells, and that of cultivated cells and cultivated cells groups were stated. As further studies, the following are mentioned: utilization of mutable genes for cross-breeding by classification and arrangement of mutable gene; and control of the direction of variation appearance in which mating of distant relations is possible. (JA)

Radiation Effects on Animals

Man

Refer also to abstracts 10348, 10504, 10562, 11710, 11711, 12017, 12036, and 12407.

10388 (CEA-CONF-2302) CYTOGENETIC DATA. Mouriquand, C.; Jalbert, P.; Chabanas, A.; Malka, J.; Bachelot, C.; Hadjian, A. J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 32p. (In French). (CONF-7209101-1). Dep. NTIS (U. S. Sales Only) $3.75.

From twenty-third congress of the French language Association of Pediatrics; Grenoble, France (11 Sep 1972).

A bibliographic review was made of studies of chromosome aberrations in relation to acute leukemia. Acquired chromosome anomalies and leukemia and constitutional chromosome anomalies and leukemia are considered. An attempt is made to interpret the chromosome aberrations observed in human patients during leukemia. (193 references) (JSR)

10389 (FDA-74-8006) PHYSICS OF DIAGNOSTIC RADIOLOGY. Proceedings of a Summer School Held at Trinity University, San Antonio, Texas, July 12-17, 1971. Wright, D. J. (ed.). (Bureau of Radiological Health, Rockville, Md. (USA)). Nov 1973. 597p. NTIS.

Thirteen lectures on the physical aspects of x radiation in relation to diagnostic radiography are included. The development of x-ray equipment; diagnostic x-ray spectra; the characteristics of radiographic films and screens; image quality and image manip-

ulation; methods for equipment evaluation; measurement of bone marrow and gonad doses; and radiation protection guides and methods for the protection of patients and personnel are discussed by a number of authorities in the field. (CH)

10390 (ORNL-4903, pp 110-114) MODEL FOR EXPOSURE TO A SEMI-INFINITE CLOUD OF A PHOTON EMITTER. Snyder, W. S.; Poston, J. W.; Dillman, L. T. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

The radiation dose absorbed by human body organs at various depths was estimated for exposure to a semi-infinite ^{85}Kr cloud. Computer analysis of the ^{85}Kr decay scheme was used to provide data for calculations of the absorbed dose per monoenergetic photons emitted. The absorbed dose at various depths in organs was calculated using an adult human phantom with 85 geometrical subregions in the trunk. (CH)

10391 (ORNL-4903, pp 131-132) EXPERIMENTAL MOCKUP OF THE SNYDER-FISHER PHANTOM. Garry, S. M.; Stansbury, P. S.; Poston, J. W. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

A physical human phantom was fabricated that resembles the mathematical phantom developed for use in Monte Carlo calculations of absorbed radiation dose. The phantom was fabricated in three principal separable regions: an elliptical cylinder representing the arms, torso, and hips; a truncated elliptical cone representing both the legs and feet; and an elliptical cylinder representing the head and neck. Each region contains inhomogeneities characteristic of a heterogeneous phantom and all the regions are confined by Lucite shells. (CH)

10392 (ORNL-4903, pp 133-138) MEDICAL X-RAY DOSE ESTIMATION PROGRAM. Poston, J. W.; Warner, G. G. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Calculations were made of the radiation dose absorbed by human testes, ovaries, thyroid, red bone marrow, and lens of the eye during exposure to x-ray beams during diagnostic radiography. The radiation dose absorbed from photons of 30, 55, and 80 keV energy was calculated by Monte Carlo techniques which trace energy deposition histories of photons incident on a mathematical representation of an anthropomorphic human phantom. A typical diagnostic table was simulated in the phantom geometry to provide a backscattering medium similar to that encountered in actual diagnostic procedures. (CH)

10393 (TID-26509) EFFECT OF IRRADIATION ON THE BIOCHEMICAL CHANGES OF MAMMALIAN CELLS IN THE ABSENCE AND PRESENCE OF PARTICULATE MATERIALS. Final Report. Sbarra, A. J.; Paul, B. B. (Saint Margaret's Hospital, Boston, Mass. (USA)). 6 Aug 1973. Contract AT(11-1)-3517. 17p. Dep. NTIS $3.00.

The effect of x irradiation on the phagocytic aspects of host defense was investigated. Leukocytes collected from x-irradiated subjects (human and animal), in general, have altered phagocytic, metabolic, enzymatic, and bactericidal activities. The alterations in these activities can be reversed by the administration of bacterial endotoxin. Lead shielding and/or ^{3}H-thymidine uptake experiments indicate that the majority of the radiosensitive cells originate in the sternum marrow. Cell synchronization studies with the administration of rabbit antineutrophilic serum (ANS) to guinea pigs suggest that the radiosensitive cells are probably multipotential cells. X irradiation of leukocytes in vitro (up to 50,000 R) have resulted in no demonstrable changes in the phagocytosis-associated activities. However, leukocytes subjected to x irradiation (1000 R) and phagocytosis concurrently have increased phagocytic and bactericidal activities. These stimulations are reversed by the addition of catalase or SH compounds. It appears that the phagocytosis-associated H_2O_2 production is involved in the antimicrobial activities of these cells. During this period significant information has become available regarding the mechanism of synergistic antimicrobial activity of H_2O_2, peroxidase (or catalase), and a halide in leukocytes collected from x irradiated and control subjects. (auth)

10394 CLINICAL RADIOLOGY. With Special Reference To Treatment. Tsuya, A. (Japanese Foundation for Cancer Research, Tokyo). Nippon Iji Shimpo; No. 2548, 43-50(Feb 1973). (In Japanese).

Topics on radiotherapy are reviewed from the radiological point of view by reference to 50 citations. The bases of treatment, such as environmental factors of the tumor, fractional dose, intensifying effect by oxygen, radiation doses during laparotomy irradiation, and physical and biological characteristics of high LET radiation are described. Irradiation at low-temperature and the studies on radioresistant carcinoma are also considered. The necessity of knowing the radiation risk in each organ in the planning of the treatment is urged, and the cases with radiation damages in the organs, particularly in the central nervous system are reported with a list of radiation tolerance doses in the organs and the tissues. Instruments for conformation method, control of the time of telecobalt irradiation by computer, and management of history of patients treated with radiation by computer, a telecobalt unit for rotating radiation with changeable angle of inclination, and application of computer are also described. Furthermore, therapeutic effects for recurrent carcinoma, cancer of the upper jaw, the larynx, the hypo-pharynx, the bottom of the oral cavity, gingiva, the esophagus, the digestive system, the breast, and the cervix of the uterus are described. Brain tumor, diseases of the thyroid gland, primary carcinoma of the lungs, malignant lymphoma, testicular tumor, and prostatic carcinoma are also examined. (JA)

10395 HOW MUCH SAFER THAN SAFE. Ellis, R. E. (Leeds General Infirmary, Eng.). Brit. J. Radiol.; 46: No. 550, 776-782(Oct 1973).

A prediction was made of the way that the three main contributors to man-made exposure of the population of the United Kingdom may develop during the next few decades. Medical exposure is expected to rise to the rate of one examination/year per head of the population. The methods by which the population dose may be limited are discussed. The technical advances that may also bring about dose reduction are indicated. It is suggested that occupational exposure should be reduced during this period of time with particular emphasis on the reduction of the maximum permissible dose level to the extremities. The need is pointed out for recommendations regarding the use of volunteers in control series in investigations involving irradiation, together with the need for continual monitoring of the environment during the development of the nuclear power program. (auth)

10396 MODERN RADIOTHERAPY IN THE TREATMENT OF CANCER. Kuttig, H. (Univ., Heidelberg). Therapiewoche; 23: No. 34, 2810-2813(1973). (In German).

The improvements in radiation therapy are surveyed. The author reports on improvements in dose distribution. These improvements were achieved by using energy-rich types of radiation, by the application of modern investigation and localization methods such as ultrasonic diagnostics, and by using computers to calculate the dose distribution. Furthermore, the use of new radiobiological knowledge, such as cell kinetics, sensitizing of the tumorous tissue by oxygen, and administration of chemical substances, is reported. (GE)

10397 ISOPLETHS OF DOSE OF EXTERNAL γ RADIATION FOLLOWING HYPOTHETICAL REACTOR HAZARDS WITH EMISSION OF NOBLE GASES. Schultz, H.; Voelz, E. (Technische Univ., Hanover). Atomkernenergie; 21: No. 2, 145-148 (1973). (In German).

There are conceivable reactor hazards in which the external β and γ radiation by noble gases of a radioactive cloud is as intense as the inhalation exposure by iodine. Therefore, it is necessary to know the maximum dose and the dose under the cloud center line as well as the area irradiated by the far-reaching γ rays. The last fact is best described by isopleths of dose. Some examples of isopleths of the external γ dose from noble gases are dealt with. (GE)

10398 MEASURES FOR CURTAILMENT OF IATROGENIC EXPOSURE. Guide to Correct X-ray Examinations. Misonoo, K. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Ishikai; 70: No. 4, 391-401(Aug 1973). (In Japanese).

Of the exposure dose for humans from various radiation sources, iatrogenic exposure amounts to $\frac{1}{2}$ to twice the natural radiation source. Although the mechanism of induction of malignant tumor by radiation is not clarified, it is evident that it is induced after receiving a dose above 100 rads. However, the presence of a threshold, under which it does not develop, is unknown. Tabulated were ICRP's calculations on the degree of risk of injury and the estimated values of genetic injury due to 1 rad. In order to estimate the harmful effect of exposure in x-ray diagnosis, the dose in the critical tissue of the human body and the types and the frequency of radiation examinations are important. The judgment of genetic injury is expressed by the genetically significant dose, which is calculated from the dose in the genital gland received by individuals. The important criterion for the judgment of physical injury is the mean annual dose per person in the marrow (mean dose in the red marrow). The dose in the genital organ is important as the dose related to the evaluation of the degree of genetic risk. The characteristics of iatrogenic exposure are partial and acute exposure and a high dose rate. Tabulated individually were the frequency of

x-ray examinations, the mean dose in the genital organ according to type of x-ray examination, contribution of each examination to the genetically significant dose, and the mean dose in the red marrow per each shot which were surveyed recently in a number of countries. Technical notes were stated for the curtailment of iatrogenic exposure in males, females, and infants. (JA)

10399 CLINICAL STUDIES ON RADIATION INJURIES RESULTING FROM ACCIDENTAL EXPOSURE TO AN IRIDIUM-192 RADIOGRAPHIC SOURCE. Sugiyama, H.; Kurisu, A.; Hirashima, K.; Kumatori, T. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 14: No. 3, 275-286(Sep 1973).

Six workers were accidentally exposed to a 5.3-Ci ^{192}Ir source. One case showed severe pancytopenia associated with marked bone marrow hypoplasia. Although no significant signs of infection and of hemorrhage were observed, he was isolated in a bioclean room and was administered with antibiotics prophylactically. He was recovered without any further measures, such as blood transfusion and bone marrow transplantation. In three cases, radiation dermatitis was observed. The ulcers developed on the buttocks of one patient were corrected surgically. Azoospermia was noted in one case and oligospermia in five other cases. (auth)

10400 HEREDITARY DISORDERS AND RADIATION RISK. Yasuda, N. (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 16: No. 4, 71-80(Apr 1973). (In Japanese).

Problems concerning the influence of x-ray exposure on human genetics are largely divided into two categories: one is the relationship between radiation dose and mutation rate, and another is the relationship between mutation and hereditary diseases. The present paper mainly describes the second problem. With special reference to the manifestation of hereditary diseases from different gene mutations, the following points were surveyed and the number of cases diagnosed as hereditary diseases were shown: (from the data of Dr. McKushick of John Hopkins University) (1) chromosome aberration, (2) dominant mutation, (3) recessive mutation, and (4) sex-linked mutation. Experimental studies of poly-gene character are described, and mutations of poly-gene character (semiquantitative and quantitative), and neutral mutation discussed. Radiation risk was calculated by assuming that subsequent generations of human beings received the total dose of 5 rad for each generation which is the limit recommended by the ICRP (International Commission on Radiological Protection) and non-hereditary diseases that occurred were discussed. One countermeasure to lower the risk of hereditary disorders suggested was the expansion of the marrying group, and it was emphasized that this is an important factor in the establishment of the maximum radiation dosage. On the other hand, the frequency of dominant mutation and hereditary diseases by chromosome aberration was logically demonstrated not to be affected by the marrying groups. (JA)

10401 RELIEF OF MASSIVE SPLENOMEGALY AFTER IRRADIATION OF LIVER INVOLVED BY WILMS' TUMOR. Spencer, R. P.; Antar, M. A.; Touloukian, R. J.; Knowlton, A. H. (Yale Univ., New Haven). J. Nucl. Med.; 14: No. 12, 939-940(Dec 1973).

In a child with metastatic Wilms' tumor and massive splenomegaly, hepatic irradiation was followed by a marked reduction in the splenic size. This may be related to at least partial relief of obstruction to the splenic outflow tract. (auth)

10402 SELECTIVE BRONCHIAL ARTERIOGRAPHY FOR THE STUDY OF THE EFFECT OF RADIATION THERAPY ON TUMOR VESSELS OF BRONCHOGENIC CARCINOMAS. Watanabe, Y.; Nagai, A.; Ohashi, H.; Yoshida, C.; Kurod, Y. (Kanazawa Univ., Japan). Nippon Kyobu Rinsho; 32: No. 9, 671-681(Sep 1973). (In Japanese).

The effect of radiation therapy on tumor vessels of the bronchogenic carcinoma was studied in 12 inoperable cases. Selective bronchial arteriography was performed before and after irradiation and results were compared. In every case, the tumor decreased in size after a course of radiation therapy, with a concomitant decrease in the vascularity of the bronchial artery. These vascular decreases were more pronounced in the cases of undifferentiated carcinoma and adenocarcinoma than in that of squamous cell carcinoma. It is specially recommended that the chemotherapy of the inoperable lung cancer should be done before the radiation therapy, especially in the cases of adenocarcinoma, which is not a radiosensitive tumor. (auth)

10403 ABSENCE OF CHROMOSOME DAMAGE IN THE NEWBORN INFANT FOLLOWING X-RAY PELVIMETRY. Bushong, S. C.; Werch, A.; Prasad, N.; Glaze, S. A. (Jefferson Davis Hospital, Houston, TX). Amer. J. Obstet. Gynecol.; 117: No. 7, 933-938(1 Dec 1973).

The radiation dose during x-ray pelvimetry to 61 patients was estimated, and the cytogenetic response of peripheral lymphocytes was determined in 25 of their newborn babies. The calculations resulted in an average midline fetal dose of 1,035 and 1,860 mrads for the patients receiving 2 projections and more than 2 projections, respectively. There was no evidence of radioinduced chromosomal damage in the newborn infants following x-ray exposure in utero. (auth)

10404 RADIATION HAZARD AND ITS MEANING FOR THE DETERMINATION OF LIMITING HEALTH PHYSICS VALUES. Koenig, W. (Staatliche Zentrale fuer Strahlenschutz, Berlin); Rossbander, W. Isotopenpraxis; 9: No. 1, 29-32(Jan 1973). (In German).

Based on the available literature, both radiation accidents and incidents are reviewed for the USA and the United Kingdom. The hazard to professionally exposed persons is compared with the accident risk in other branches of industry. In East Germany, approximately 30,000 persons (0.2 percent of the population) are presently employed in professions involving radiation exposure. For more than 96 percent of the personnel, the radiation burden is less than 0.5 rem/year. Only for about one percent of the personnel, the burden ranges from 1.5 to 5.0 rem/year. It appears feasible that the radiation burden can be reduced to 10 percent of the permissible limit for all professionally exposed individuals. (HBG)

10405 BIOLOGICAL EFFECTS OF LOW IRRADIATION DOSES IN MAN. Goutier, R. (CEN, Mol, Belgium). Electricite; No. 156, 9-14(1973). (In French).

The principal results and recent estimations of the probable biological effects of low doses of radiation are reviewed. Numerous reports of the scientific committee of the United Nations for the study of the effects of atomic radiation are abstracted. (FR)

10406 EXPERIMENTAL SURVEY OF DENTAL X-RAY EQUIPMENT. Castagne, R.; Sarandrea, M.; Venier, A. Securitas; 57: No. 7, 585-592(Jul 1972).

Results are presented of a series of tests carried out in Italy to ascertain the degree of safety of dental x-ray apparatus and any radiation hazards involved. The Röpak investigation method was followed, using a special photographic emulsion which, exposed when the apparatus to be tested is being operated in a specific manner, enables the radiation to be determined quantitatively and qualitatively and any protection and shielding defects in the equipment to be detected. The exposed plates were examined and recommendations were drawn up, on the basis of the investigation, for better use of this equipment. The investigation also showed the urgent need for Italian regulations concerning the design, construction, maintenance, and use of this equipment, with standard specifications comparable with those of the other EEC countries. (Occup. Saf. Health Abstr.)

10407 INCIDENCE OF MALIGNANT LYMPHOMA AND MULTIPLE MYELOMA IN HIROSHIMA AND NAGASAKI ATOMIC BOMB SURVIVORS, 1945–1965. Nishiyama, H.; Anderson, R. E.; Ishimaru, T.; Ishida, K.; Ii, Y.; Okabe, N. Cancer; 32: No. 6, 1301-1309(Dec 1973).

The present study demonstrates an increased prevalence of malignant lymphoma and multiple myeloma in survivors of the atomic bomb in Hiroshima exposed to 100 rad or more; a similar relationship is not evident in Nagasaki. This apparent discrepancy is tentatively attributed to known physical differences in the radiation spectrum emitted by the 2 bombs and/or biological differences between the inhabitants of Hiroshima and Nagasaki. Other observations of interest include the following: the risk of developing lymphoma or multiple myeloma appears to be greater in persons exposed at less than 25 years of age than in people who were 25 or more years old at the time of the bomb; the appearance time is shorter in the younger age group exposed to 100 rad or more in comparison with less heavily exposed persons, and also in comparison with heavily exposed persons in the older age groups. (auth)

10408 THOROTRAST INDUCED TRANSITIONAL CELL CARCINOMA IN A RESIDUAL URETER AFTER NEPHRECTOMY. Mihatasch, M. J.; Rutishauser, G. (Univ., Basel). Cancer; 32: No. 6, 1346-1349(Dec 1973).

The first case of Thorotrast-induced ureteral carcinoma is reported. This tumor developed in the ureteral stump 15 years after nephrectomy and 39 years after retrograde pyelography with Thorotrast. (auth)

10409 APPLICATIONS OF LINEAR ACCELERATORS. Masuda, M. (National Lab. for High Energy Physics, Oho, Japan). Genshiryoku Kogyo; 19: No. 7, 16-20(Jul 1973). (In Japanese).

The principles and features in medical use of the electron LINAC and proton LINAC are described. The electron LINAC has exerted a great effect in performing irradiation of electron beam to cancers situated in the deep body cavity in combination with surgical operation and is put into practical use extensively. The proton LINAC put into practical use following the electron LINAC is effective for the in vivo treatment of cancer since the range of proton beam in water is 25 cm at 200 MeV. In addition, by altering the energy of the LINAC, it is possible to control precisely the position of the Bragg peak to the depth of ±0.5 mm. The Bragg peak is large, and there is very little horizontal scattering of the beam. When a large beam width is used, it is possible to adjust the depth to give uniform dose to the target tissue in vivo. The LINAC of the Brookhaven National Laboratory has an output of 3×10^{11} protons/pulse and can give a high dose rate of 1000 rads/pulse to tumor tissues. It has a maximum LET of 40 to 50 KeV and an OER of 2 to 2.5. The proton synchrotron of the Institute of High Energy Physics accelerates the proton beam to 1.2 GeV. Manufacturing of radioisotopes and the possibility in medical use, such as irradiation, of this instrument are discussed. By supposing an accelerator of 25 MeV, 1000/sec at 1 m, the amount of short-life radioisotopes (^{15}O, ^{11}C) manufactured was calculated. (JA)

10410 OVARIAN RADIATION DOSAGE DURING FLUOROSCOPIC HYSTEROSALPINGOGRAPHY. Uemura, T. (Yokohama City Univ., Japan); Shiojima, Y.; Suzuki, N.; Negishi, T. Nippon Sanka Fujinka Gakkai Zasshi; 24: No. 12, 1153-1161 (Dec 1972). (In Japanese).

Ovarian radiation dose in the TV-hysterosalpingography (abbreviated as TV-HSG) was measured, and this was compared with that in the usual HSG or radiographic pelvimetry conducted in the terminal stage of pregnancy. As a measure to reduce the radiation doses without spoiling the advantage of the fluoroscopy in TV-HSG, the fluoroscopy was continued intermittently by an operator manipulating a foot switch 1 to 3 times per sec. (This method is abbreviated as intermittent TV-HSG.) The subjects of this study were 30 cases of the TV-HSG, 20 cases of the intermittent TV-HSG, and 7 cases of the radiographic pelvimetry. In the HSG, ovarian radiation doses in three trials averaged 200 ± 65 mR. In the TV-HSG, the fluoroscopic time averaged 2 min 19 sec ± 44 sec, the ovarian radiation doses averaged 543 ± 200 mR, and the total ovarian radiation dose averaged 673 ± 218 mR including two x-ray exams. In the intermittent TV-HSG, the fluoroscopic time averaged 36 ± 13 sec, the ovarian radiation doses averaged 173 ± 55 mR, and the total ovarian radiation doses averaged 311 ± 59 mR including two x-ray exams. In the radiographic pelvimetry, the ovarian radiation dose averaged 246 ± 50 mR and 346 ± 75 mR by the exam. of the ventral-ward picture and the lateral-ward picture respectively, and the radiation doses averaged 592 ± 88 mR including two x-ray exams. The correlation between the fluoroscopic time and the radiation doses was shown by the correlation coefficient, r = 0.8323, significant level, p 0.001, and the regression line being y = 3.3x + 75.8 (x: time, y: ovarian radiation doses). In the intermittent TV-HSG, the fluoroscopic time and the ovarian radiation doses were approximately ¼ and ⅓ respectively those in the TV-HSG. The total ovarian radiation doses in the intermittent TV-HSG was approximately ½ that in the radiographic pelvimetry, and it was 1.5 times that in the HSG. (JA)

10411 INTERCAPILLARY GLOMERULOSCLEROSIS IN SURVIVORS OF THE ATOMIC BOMBS IN HIROSHIMA AND NAGASAKI. Guttman, P. H.; Yamamoto, T.; Connor, R. J. (Atomic Bomb Casualty Commission, Hiroshima). Hiroshima Igaku; 25: No. 12, 1512-1520(Dec 1972). (In Japanese).

Subjects investigated were survivors of the nuclear explosions in Hiroshima and Nagasaki, who were selected from vital statistics conducted during 1950 to 1953. Ninety-five percent of those survivors were personally interviewed, and their exposure doses were estimated considering their circumstances at the time of the atomic explosion. Pathological changes in glomeruli were examined with the hematoxylin eosin dye method of the kidney tissues obtained by biopsy during 1961 to 1968 from those exposed to more than 100 rads and those who were under 6 years old at the time of the explosion and died during 1961 to 1968 and from the control group. Among those who were exposed as a child to high radiation doses and died before 30 years of age, the occurrence rate of glomerulosclerosis was high particularly among those who received higher exposure doses. It is suggested that some correlation exists between glomerulosclerosis and age factors such as death age and survival time; however, no correlation was found from this study. In the group who were exposed to more than 100 rads and who were more than 70 years old at the time of biopsy, no correlation was found between glomerulosclerosis and radiation exposure dose. In the patients with glomerulosclerosis, complications with diabetes mellitus and leukemia were found frequently, while complications with vascular diseases were found less frequently. (JA)

10412 THREE CASES OF RADIATION CANCER IN HEAD AND NECK. Yoshimura, J.; Kitamura, K.; Yamaguchi, H.; Sawaki, S. (Yokohama City Univ., Japan). Jibi To Rinsho; 19: No. 2, 166-171(Mar 1973). (In Japanese).

Three cases, previously treated with x-ray therapy for the cervical tuberculous lymphadenitis, were diagnosed as radiation cancer. Tumors were located in the neck, hypopharynx, and larynx, respectively. The severe radiation damage on the skin or subcutaneous tissues of the neck was observed in all cases. The latent period of the three cases ranged from 28 to 37 years. The etiology of the irradiation cancer was diagnosed. The prophylaxis of the irradiation cancer should be emphasized. (auth)

10413 GLUCOSE-6-PHOSPHATE DEHYDROGENASE IN THE TISSUES OF CERVICAL CANCER UNDER RADIATION THERAPY. Kibayashi, A. (Iwate Medical Coll., Morioka, Japan). Gan No Rinsho; No. 3, 231-240(Mar 1973). (In Japanese).

Variation in glucose-6-phosphate dehydrogenase (G6PD) activity and its isozyme pattern under the radiation therapy as well as their relationship to the histological findings were studied on 29 cases of cervical cancer. Significant difference was observed between the normal cervical tissue and the cancerous tissue in the activity of G6PD. The G6PD activity in the cancerous tissue of the cervix decreased after irradiation. The G6PD isozyme pattern composed of three fractions showed some difference between the cancerous tissue and the normal tissue. In the cancerous tissue the fraction I of G6PD was low, but the fraction II was high in some cases while low in other cases, and the fraction III was always high. The cancerous tissue of the patients whose fraction II was initially low and turned into an increase after irradiation revealed the marked radiosensitivity showing notable histologic degeneration. (auth)

10414 TUMOR REGRESSION DURING RADIOTHERAPY FOR CANCER OF THE LUNG. Ogawa, F.; Eto, T.; Hayashi, S. (Kyoto Prefectural Univ.). Gan No Rinsho; 19: No. 1, 15-21 (Jan 1973). (In Japanese).

The volumetric study of lung cancer on the chest roentgenogram was performed on 48 cases. The regressions of tumors were classified to five patterns, and regression curve analysis showed them to be exponential essentially. There was significant correlation between tumor regression and histological type of tumor cells and there was no correlation between tumor regression and prognosis. Volume doubling times were measured on some tumors. The accuracy of some volumetric methods of lung tumors using chest roentgenogram were also studied. (auth)

10415 PHYSICAL AND BIOLOGICAL PRINCIPLES OF NEUTRON THERAPY. Pohlit, W. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Frankfurt am Main). Strahlentherapie; 145: No. 5, 491-503(1973). (In German).

The basic principles of therapy with fast neutrons are discussed. For this purpose, three fields are considered: the physical field; the physico-chemical field; and the biological field. In the physical field, no advantages are to be found in the dose distribution, in the influence of scattering, and in the consideration of inhomogeneities in the irradiated tissue. In the physico-chemical field, the marked advantage of fast neutrons is the avoidance of the oxygen effect, which must be expected under sparsely ionizing radiation. In the biological field, one can expect less effective repair after irradiation with fast neutrons than with sparsely ionizing particles. This reduces the desirable difference in the effect on tumor and healthy tissue of fractionated irradiation, and special attention must be given to this fact in practical therapy. (GE)

10416 GROWTH IMPAIRMENT FOLLOWING IRRADIATION IN ONE OF A PAIR OF MONOZYGOTIC TWINS. Lyons, A. R.; Grebbell, F. S.; Nevin, N. C. (Queen's Univ., Belfast). Clin. Radiol.; 24: No. 3, 370-375(Jul 1973).

A study was made of growth impairment in one of a pair of monozygotic twin boys who was irradiated at the age of 34 months following nephrectomy for a Wilms tumor of the right kidney. The patient, now aged 15, is in good health. Considerable interference with growth is evident in the irradiated bone and soft tissues. Post-operative radiation was 2,500 rads over a period of 33 days, followed, 8 months later, by a dose of 2,420 rads over a period of 21 days, given after the appearance of a secondary lung tumor. Comparison is made with the normal twin. (auth)

10417 INFLUENCE OF FOCAL LOCALIZATION AND POSITIONING OF THE PATIENT ON THE DOSE DISTRIBUTION.

Richter, J. (Robert-Roessle-Klinik, Berlin). Strahlentherapie; 145: No. 5, 556-560(1973). (In German).

By an example of cineroentgenotherapy it is shown that the correlation between focus and dose distribution becomes incorrect if the following conditions are not fulfilled: the focal localization must be exact; the patient's positioning must be accurate and constant during irradiation; and the position must be reproducible. As faults may occur that by far outweigh the mistakes originating from the determination of the dose distribution, it is especially important to improve the methods of focal localization, the positioning of the patient, and the position controls. (GE)

10418 NEW GAMMA RAY EXPOSURE ESTIMATION METHOD FOR RADIATION ACCIDENTS. Nakajima, T.; Fujimoto, K.; Hashizume, T. (National Inst. of Radiological Sciences, Chiba, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 4, 202-206(Apr 1973).

There occurred in 1971 an accidental exposure to γ rays from an ^{192}Ir source received by persons not regularly occupied in radiation work. To serve in planning the therapeutic treatment, a method for estimating the γ-ray exposure received by these persons was devised. The method is based on the idea of using bearing jewels collected from the patients' wrist watches as monitor sample for tests on their thermoluminescence. Applying this method, it was estimated that the exposure sustained by the three patients in question was 761, 77, and 40 R. The method thus developed should prove useful for estimating the exposure sustained by patients involved in a radiation accident. (auth)

10419 PRINCIPLES FOR STUDYING THE EFFECTIVENESS OF RADIOPROTECTORS IN MAN. Dzharak'yan, T. K.; Vladimirov, V. G.; Gus'kova, A. K.; Yarmonenko, S. P. (Inst. of Experimental and Clinical Oncology, Moscow). Med. Radiol.; 18: No. 9, 57-64(Sep 1973). (In Russian).

The literature is reviewed with 46 references. (ERB)

10420 BLASTOMOGENIC AND ANTITUMOR EFFECT OF RADIATION OWING TO THE ACTION ON THE PROTEIN COMPOSITION OF THE BODY TISSUE. Surinov, B. P. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 18: No. 11, 79-89(Nov 1973). (In Russian).

The literature is reviewed with 100 references. (ERB)

10421 DIAGNOSTIC PROBLEMS AFTER RADIOTHERAPY INVOLVING THE LUNG. Lamoureux, K. B. (National Cancer Inst., Bethesda, MD). S. Med. J.; 66: No. 12, 1388-1392(Dec 1973).

Many types of cancer are being treated with radiotherapy in combination with, or before, chemotherapy. Pulmonary complications from treatment with many chemotherapeutic agents alone have been cited frequently. However, the chemotherapist may overlook the possibility of radiation reaction when confronted with a patient with a pulmonary problem. Case reports that help to point out some of the pitfalls in diagnosis after a full course of radiation is delivered to a significant portion of the lung are included. (CH)

10422 PHANTOM INVESTIGATION OF DOSE DISTRIBUTION DURING CESIUM TELERADIOTHERAPY OF TUMORS IN THE THORACIC AND ABDOMINAL CAVITY. Huxoll, G. Essen; Bochum Univ. (1971). 75p. (In German).

Thesis.

The characteristic properties of cesium teleradiotherapy of tumors in the thoracic and abdominal cavity with a 2,000 Ci ^{137}Cs source are discussed by means of metrological investigations with the Alderson phantom. Part one of the thesis deals with the methodical aspects of the phantom and metrology along with the possible sources of error. Part two presents three different methods of irradiation of intrathoracic tumors, one for irradiation of the retroperitoneal space (malignant lymphoma, scrotal tumors), one for parametrium irradiation of the collum carcinoma, and one for three-area-irradiation of carcinoma of the urinary bladder. With reference to preservation of spinal marrow, heart, and kidneys the discussed methods of irradiation are critically compared to each other. Other irradiation plans are suggested. (GE)

10423 NATURAL RADIATION EXPOSURE TO MAN. External Exposure to Terrestrial Radiation in the Open Air. Schales, F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Frankfurt am Main); Franke, T.; Keil, R. A. (1973). vp. (In German).

From natural radiation exposure of man: basis for judging the radiation risk; Frankfurt am Main, Germany (18 Jul 1973).

The exact knowledge of the dose of natural radiation exposure to man along with its deviation is an essential reference quantity for estimation of all additional radiation effects due to application of radionuclides and nuclear energy in human civilization. The natural terrestrial radiation is mainly from the gamma-emitting radionuclides of the radioactive series of uranium-radium and thorium, and by ^{40}K existing in the soil. The contribution of the other natural radioisotopes and of the atmosphere and hydrosphere are negligible, also the α and β components of the terrestrial environmental radiation, which are absorbed by clothes and surface layers of the human body. Following a short comparative treatment of the general measuring methods for environmental radiation (ionization chamber, NaJ(Tl)-scintillator, thermoluminescence dosimeter), the results of measurement in the FRG (1961 to 1965) are presented and discussed. In 1964/65 the outdoor dose value per person for the population of Hessen was measured between 40 and 70 mrd/a, the mean value being 55 mrd/a with deviation of ±10 mrd/a. A table is presented of the mean terrestrial outdoor dose rate per person in 10 other countries (UNSCEAR-report 1972), the overall average value being 60 mrd/a. The dose rate in the gonads, bone lining cells, and bone marrow, which is significant for radiation hazards, is assumed to be 80% of the outdoor dose rate. Its mean value in the FRG was measured to be 44 ± 8 mrd/a per person. (GE)

10424 MODIFICATION OF ISODOSE CURVES BY MEANS OF COMPENSATING FILTERS. Sorensen, N. E. (Radium Center for Jutland, Aarhus, Denmark). Acta Radiol., Ther., Phys., Biol.; 11: No. 6, 590-592(Dec 1972).

A method of modifying isodose curves by means of compensating filters in the treatment of malignant disease of the neck is described. This is required when the shoulders interfere with parallel opposing fields in radiation therapy. (auth)

10425 RADIATION-PROTECTIVE ACTION AND POSSIBLE MECHANISMS OF ACTION OF SOME POTENTIAL RADIATION-PROTECTIVE AGENTS. Bogatyrev, G. P.; Goncharenko, E. N.; Chirkov, Yu. Yu.; Kudryashov, Yu. B. (Moscow State Univ.). Biol. Nauki; 113: No. 5, 50-53(1973). (In Russian).

Some aminoalkylthiosulfuric acids are potential radiation protection agents. Their radiation-protection action depends on the degree of decrease in the oxidation-reduction potential in the tissue of the animal under the influence of these compounds. Data were obtained on the effect of the potential radiation protectants on the biogenic amine (serotonin, histamine), loosely bound phospholipid, and lipid oxidation product contents of tissue. The mechanism of action of the radiation protectants studied is considered to include the "formation of a biochemical background of radiation resistance of the organism." (tr-auth)

10426 OVER-EXPOSURE DURING WORK WITH X-RAY CRYSTALLOGRAPHIC EQUIPMENT. Linsley, G. S. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 5, 15-16(Oct 1973).

A case is recorded of over-exposure received by an experienced service engineer of a firm manufacturing x-ray crystallographic equipment. The first indication of an incident was the development of a radiation burn on two fingers of the left hand. Reconstruction of the subject's movements during the previous month indicated that the incident occurred whilst servicing a Technical College diffraction apparatus. The safety shutter mechanisms and a filter disc had been removed to enable the tube head to be aligned by hand. Subsequent measurements at the tube window using thermoluminescent dosemeters, showed the dose rate to be ~120 rads/sec at a tube of 20 Kv, 6 mA. A radiotherapy specialist concluded that the burn's appearance was consistent with a dose of 1500 to 2000 rads of x radiation. The skin appearance and surface tissues appeared to recover after several months. The equivalent whole body dose, estimated by chromosome aberration analysis, was below the level of detection of the technique (i.e. less than ~15 rads.) (UK)

10427 PATIENT EXPOSURES IN DIAGNOSTIC RADIOLOGY: ICRP STATEMENT. Radiol. Prot. Bull.; No. 5, 10-13; 16(Oct 1973).

Patient exposure in diagnostic radiology is discussed in outline with reference to ICRP Committee 3 Publications 15 (1970) and 16 (1970). The subject is presented under the following headings: The need for protection of the patient, balance between benefit and risk, dissemination of ICRP recommendations, and observations on the current situation, including examination frequency, type and purpose of examinations, radiological techniques, dose per examination, doses of special interest (e.g. to gonads and active bone marrow), and means of dose reduction. (UK)

Vertebrates

Refer also to abstracts 10369 and 10379.

10428 (COO-3269-4) NINTH YEAR PROGRESS REPORT, AUGUST 1, 1972–JULY 31, 1973. Shaber, G. S. (Thomas Jefferson Univ., Philadelphia, Pa. (USA). Hospital). 1973. Contract AT(11-1)-3269. 5p. NTIS $3.00.

Rats that received 100 R of in utero x irradiation on the eighteenth day of gestation survived hypothalamic electrode implantation poorly; exhibited a diminished response to hypothalamic stimulation; and showed no significant difference in their pre- and post-tongue radiation saccharin taste threshold. (auth)

10429 (LBL-2449) CAPILLARY PERMEABILITY AND LYMPH FLOW IN THE IRRADIATED RAT. Graham, M. M.; Dobson, E. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 93p. Dep. NTIS $6.75.

Thesis.

Exposure of rats to 700 rads whole-body ^{60}Co γ irradiation increased capillary permeability by 47% and increased lymph flow by 124% 48 hrs following irradiation, while exposure to 1000 rads caused an increase of capillary permeability of 98%, but did not change lymph flow from control values. The latter result may have been due to the relative dehydration and immobility of the 1000 rad group. Rats drinking large quantities of 5% dextrose + 0.7% NaCl solution did not increase lymph flow measurably above control levels. (CH)

10430 EFFECTS OF GLUTATHIONE ON MITOTIC DELAY INDUCED BY X IRRADIATION IN EHRLICH ASCITES TUMOR CELLS. I. Kawasaki, S.; Sakurai, K. (Yamaguchi Univ., Ube, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 6, 535-540(Jun 1973). (In Japanese).

The radioprotective action of glutathione (GSH) was studied at the cytological level using the mitotic index of Ehrlich ascites tumor cells. After irradiation with 100 and 200 rad, the rate of recovery of mitotic index in the group treated with 30 mg GSH was similar to that in the control group. But 12 hours after irradiation and on, the mitotic index increased more than the value of the control. With 400 and 600 rad, the recovery of the mitotic index was accelerated by the pretreatment with 30 mg GSH. Treatment with GSH alone induced a slight decrease in the mitotic index and later a marked increase at 9 to 12 hours. These data might suggest that the action of GSH is related to the cell cycle. (auth)

10431 EFFECTS OF GLUTATHIONE ON MITOTIC DELAY INDUCED BY X IRRADIATION IN EHRLICH ASCITES TUMOR CELLS. II. Kawasaki, S.; Sakurai, K. (Yamaguchi Univ., Ube, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 6, 541-545(Jun 1973). (In Japanese).

The radioprotective action of glutathione(GSH) was studied at the cytological level using the mitotic index of Ehrlich ascites tumor cells. Glutathione (30 mg/mouse) was administered intraperitoneally 30 min and 3 and 6 hrs before irradiation with 400 rad. Glutathione accelerated the recovery of mitosis after irradiation. The action was most intense when it was administered 30 min before irradiation, followed by the administration 3 and 6 hrs before irradiation. Thirty minutes, 3 hrs, 6 hrs, and 9 hrs after irradiation with 400 rad, glutathione (30 mg/mouse) was administered intraperitoneally. When glutathione was administered after irradiation, the reappearance of mitotic cells was inhibited. Such inhibition was most intense when it was given 3 hrs after irradiation. Changes of mitotic index after administration of glutathione (0, 5, 10, 20, 30, and 40 mg/mouse) alone were observed. The mitotic index in the groups with the administration 20 to 40 mg of glutathione showed a slight decrease until 6 hrs after administration, and then showed a marked increase 12 to 15 hrs after administration. On the basis of these data, the mechanisms of the radioprotective action of glutathione are discussed. (auth)

10432 HEMATOLOGIC RESPONSE OF SHEEP AND CATTLE TO WHOLE-BODY GAMMA IRRADIATION AND GASTROINTESTINAL AND SKIN BETA IRRADIATION. Sasser, L. B.; Bell, M. C.; Cross, F. H. (Univ. of Tennessee, Oak Ridge). Amer. J. Vet. Res.; 34: No. 12, 1555-1560(Dec 1973).

Peripheral blood cell counts were determined in 48 sheep and 64 cattle fed a ^{90}Y-fallout simulant (gastrointestinal (GI) irradiation); exposed to whole-body (WB) gamma irradiation (240 R), exposed to beta irradiation of the skin (57,000 rads to the dorsal area), or given combinations of these treatments. Leukopenia and thrombocytopenia occurred in the 2 species at 1 to 3 weeks after WB irradiation. A typical decrease in lymphocytes occurred after WB irradiation, and a slight decrease, after skin irradiation, GI irradiation, or both. Skin and GI irradiation together (without WB irradiation) produced significant thrombocytosis beginning 3 to 4 weeks after treatment. Skin and GI irradiation had little effect on the hematologic response produced by WB irradiation during the initial stages, but did affect the number of cells during the recovery stage. (auth)

10433 EFFECTS OF TEMPERATURE, RADIATION, AND SEX ON BODY COMPOSITION IN MICE (PEROMYSCUS POLIONOTUS). Scarth, R. D.; Leverett, C. O.; Scarth, L. L.; Smith, M. H.; Carmon, J. L. (Univ. of Georgia, Athens). Growth; 37: No. 4, 311-321(Dec 1973).

Cumulative effects of temperature (16°C and 24°C) γ-irradiation of males in seven prior generations, and sex on % ether extract, % protein, % water, and % ash of whole body weight were studied in 84 mice (Peromyscus polionotus). One week prior to mating, males were irradiated with either 0 R, 100 R, or 200 R gamma radiation. Heavier mice tended to have higher % ether extract and lower % H_2O than lighter mice. Per cent ash was not significantly related to other measurements of composition or to live weight. The 100 R line had a higher % H_2O than the other two radiation lines and higher % protein than the 0 R line. The radiation effect on % H_2O was not consistent in the two temperatures. Mice sired by males treated with 200 R had lower % H_2O at 16°C than at 24°C; whereas, the opposite was true for the other two radiation levels. Mice in the 200 R line had higher % ether extract than in the 100 R line. Radiation tended to increase % protein compared to 0 R. Males were fatter than females. Mice from the 16°C lines had lower % ether extract and higher % protein and % H_2O than mice from the 24°C lines. However, on a fat free basis, % protein and % H_2O were not significantly different for the two temperature groups. Per cent ash in 24°C mice was more than 1.5 times the % ash found in 16°C mice. (auth)

10434 MICROCIRCULATION OF IRRADIATED SPONTANEOUS OSTEOSARCOMA IN DOGS. A Preliminary Report With Special Reference To the Effect of Fractionation. Paatsama, S.; Rissanen, P.; Rokkanen, P.; Sittnikow, K. (Coll. of Veterinary Medicine, Helsinki). Acta Radiol., Suppl.; No. 319, 153-158(1972).

From proceedings of the 2nd international conference of veterinary radiologists; Stockholm, Sweden (1970).

Of 13 dogs with spontaneous osteosarcoma, six were irradiated with a Caesatron. Three dogs received 1000, 2000, and 3000 rad respectively in a weekly dose of 1000 rad. Three dogs received the corresponding weekly dose in daily fractions. Microangiographic examination showed that the large doses caused obstructions of small blood vessels and obstructions and constrictions of the larger vessel. One thousand rad given in five daily fractions caused no noticeable vascular changes. Two thousand and 3000 rad given as daily fractions caused slight changes in the minor blood vessels while the larger vessels remained open. (auth)

10435 DEMONSTRATION OF SPLEEN COLONIES ON GRAFTED SPLEENS IN THE RADIATION CHIMERA. Boynton, A. N.; Crouse, D. A.; Sharp, J. G. (Univ. of Iowa, Iowa City). Scand. J. Haematol.; 11: 92-96(1973).

The post-irradiation development of countable endogenous spleen colonies in spleens transplanted intraperitoneally 6 weeks prior to x irradiation of the host was demonstrated, and so were countable exogenous spleen colonies on spleen grafts transplanted prior to the irradiation of the host and the injection of bone-marrow cells. Although autografted spleens in irradiated recipients did not attain their presplenectomy mass, the number of colony forming units (CFU)/10^5 injected cells assayed after irradiation and bone-marrow cell injection was about the same as in sham-splenectomized mice. Isografted spleens in sham-splenectomized mice were much smaller than the host or autografted spleens and the number of CFU/10^5 injected cells assayed per isograft was only 25 to 33% of that observed in host mice. (auth)

10436 EFFECTIVENESS OF BORONATED TETRACYCLINE ANTIBIOTIC DERIVATIVES (AT_2B_2) AS THE BORON-10 CARRIER IN NEUTRON CAPTURE THERAPY. Gillschriest, W. C.; Shaw, D. H. Oncology; 27: 97-104(1973).

Commercially available transplantable adenocarcinoma (T1703) in Jackson Laboratory mice (DBA/1J) were studied using T_2B_2 to carry ^{10}B for ^{10}B thermal neutron capture therapy. The UCLA thermal neutron fluence was 2.7×10^{12} $_{th}$n/cm^2 and exposure was total body. There were no signs of typical radiation damage to skin, gastrointestinal tract, or hematopoietic system. The results indicated a significant ($p = <0.01$) increase in mean survival of 15.85 days between T_2B_2 and Tc controls. Retardation in neoplastic growth was observed, and apparent permanent regression was achieved in 22.7% of the T_2B_2-treated animals. (auth)

10437 CIRCADIAN RHYTHMS OF FREE RADICAL STATE CONCENTRATIONS IN THE ORGANS OF MICE. Piruzian, L. A.; Kovalenko, O. A.; Chibrikin, V. M. (Inst. of Chemical Physics, Moscow). Aerosp. Med.; 44: 902-904(Aug 1973).

From 43rd annual scientific meeting; Bal Harbour, Florida (8 May 1972).

In recent years there has been considerable interest in the role played by free radical states in the genesis of various pathological processes and during stress conditions. The free radical state

concentration in animal tissue was found to change during tumor growth and radiation damage to the organism. These changes in free radical state concentration were determined with respect to controls. It was of interest to examine the effects of various physical factors on daily free radical fluctuations. Starvation for seventy-two hours was found not to noticeably affect the phase, period, or amplitude of the fluctuations. Although x-ray radiation disrupted redox reactions, free radical fluctuations were not noted thirty days after mice were irradiated. (auth)

10438 EXPERIMENTAL THERAPY OF THE POSTIRRADIATION BLOOD COAGULATION DISORDER. Pospisil, J.; Klir, P.; Skala, E.; Dienstbier, Z.; Vranovska, J.; Zitko, M. (Carl Univ., Prague). Cas. Lek. Cesk.; 112: No. 24, 754-756(1973). (In Czech).

It is shown that ϵ-aminocaproic acid, administered orally at the dosage level of 0.4 g/kg/day to dogs subjected to whole-body irradiation, will improve in part the postirradiation blood coagulation disorder. In experiments made on rats, rabbits, and dogs subjected to whole-body irradiation, it was shown that ellagic acid, administered by the intravenous route, will markedly reduce the bleeding time and favourably influence some blood coagulation tests. (auth)

10439 CELLULAR KINETICS IN BLOOD-FORMING ORGANS AFTER X IRRADIATION. Kawara, K. (Yamaguchi Univ., Ube, Japan). Igaku Kenkyu; 42: No. 3, 150-158(Nov 1972). (In Japanese).

The total number of lymphocytes in the thymus markedly decreased during the first 5 days after x irradiation. Lymphocyte depletion in the first phase was greatest in the thymus. This suggests that the thymic lymphocytes may be more sensitive than those of other lymphoid organs. Moreover, the most pronounced repopulation of thymic lymphocytes 10 days following the initial decrease suggests an important role of thymus in the recovery from irradiation damage of other lymphoid organs. The depletion and repopulation of lymphocytes in the three lymphoid organs and bone marrow were compared by estimating the number of lymphocytes that were contained in 1 mg of each organ at various periods after x irradiation. The degree of lymphocyte depletion at the earliest periods following irradiation was the highest in bone marrow, followed by the thymus, spleen, and mesenteric lymph nodes, in decreasing order of depletion. The bone marrow lymphocytes may be more radiosensitive than thymic lymphocytes. The transient increase in lymphocyte numbers following the early depletion was also the greatest in the bone marrow, followed by the thymus. This suggests that bone marrow and thymic lymphocytes play an important role as stem cells. Lymphocytes were classified into the three types according to their cell diameter (small: less than 9.0 μ, medium-sized: 9.1 to 13 μ, large: larger than 13.1 μ), and the changes in their absolute number after irradiation were observed. The three types of lymphocytes in each organ exhibit an initial sharp decrease, followed by a transient, marked repopulation 10 days after irradiation. The repopulation of large and medium-sized lymphocytes restored the cell number beyond the control level, but the increase of small lymphocytes failed to restore the cell number to the control level. Thus, the repopulation of large and medium-sized lymphocytes tended to precede that of small lymphocytes in all of the three lymphoid organs. A marked proliferation of plasma cells in the mesenteric lymph nodes and spleen was seen after 7 days; however, no proliferation of these cells was observed in the thymus and bone marrow. (auth)

10440 GRANULOPOIESIS IN THE APLASTIC BONE MARROW OF X-IRRADIATED RATS AFTER PARABIOSIS WITH HEALTHY LITTER-MATE BY AORTIC ANASTOMOSES. Fang, C. H. (Okayama Univ., Japan). Acta Med. Okayama; 26: No. 1-2, 1-10(Apr 1972).

For the purpose of revealing how the aplastic bone marrow of lethally irradiated animals restores hemopoietic activity after the anastomosis with healthy animals, the femural bone marrow of rats that received whole-body x irradiation (1,000 R), were parabiosed with healthy litter-mates by aortic anastomoses, and were sacrificed at certain intervals after parabiosis was observed. RNA and DNA synthesis was observed with ^{3}H-Ur and ^{3}H-Tdr in vitro. By whole-body x irradiation with 1,000 R, all the immature cells in the bone marrow were eradicated by 3 days and the animals died 4 to 5 days after irradiation when the animals were left without parabiosis. But by parabiosis with healthy litter mates 3 days after irradiation, the hematopoietic activity in the bone marrow recovered completely on the third to fourth day. A mass of mature granulocytes were settled in the aplastic bone marrow at least 6 hrs after parabiosis. Some of the granulocytes were enlarged and had basophilic cytoplasm. A few of myelocytes appeared after 12 hrs, and promyelocytes after 18 hrs. Mitoses were hardly observed by 12 hrs. The large sized granulocytes appearing after 6 hrs, showed RNA synthesis but not DNA synthesis. DNA synthesis began to occur after 18 hrs in myelocytes and promyelocytes. The data suggest that granulocytes have the ability to dedifferentiate and probably acquire the character of younger procursor cells. (auth)

10441 FURTHER INVESTIGATIONS INTO THE MODE OF ACTION OF THE ANABOLIC STEROIDS IN RADIATION PROTECTION. Panek, R. (Academy of Medicine, Bialystok, Poland); Baran, S. Strahlentherapie; 145: No. 4, 443-452(1973). (In German).

The effect of Dianabol on the post-radiological changes in protein synthesis in the individual subcellular fractions of kidney and liver, on the synthesis of DNA in homogenates of these tissues, and on the post-radiological disturbances in the more stable protein of skin collagen were investigated in 350 Wistar rats. The administration of Dianabol for 20 days stimulated the assimilation of ^{14}C-leucine into the proteins of the homogenate and of the nuclear fraction, and especially the mitochondrial fraction of the liver and kidneys. It has no significant effect on the assimilation of ^{14}C-thymidine into the DNA of these tissues. It also has no effect on the total collagen content in the skin; it lowers the level of the soluble collagen fraction by about 75%. The radiation dose of 500 R at first caused a reduction of assimilation of leucine into the proteins of the homogenate and of the subcellular fractions with a subsequent significant increase. Irradiation inhibits the assimilation of thymidine into the DNA of the tissues examined by about 80%. Irradiation of animals that were previously given Dianabol did not alter the assimilation rate of ^{14}C-leucine into the proteins investigated. This process occurs in every case as in animals that have received Dianabol. Also no reduction was observed in the intensity of assimilation of thymidine into the DNA of the irradiated animals that had recieved Dianabol. On the other hand, in the investigations on the collagen a still greater reduction was shown in the level of the soluble collagen fraction with a simultaneous increase in the total collagen content in comparison with the irradiated group. From the investigations, it is assumed that the effect of Dianabol on the post-radiological disturbances of synthesis of protein and nucleic acid plays a considerable part in the mechanism of its radiation protection action, which is different in different fractions of tissue protein. (GE)

10442 GHANGES IN RATIOS OF HIGH-MOLECULAR-WEIGHT FATTY ACID-COMPOSITION, CONSTITUTING HEPATIC LIPIDS IN IRRADIATED ANIMALS. 2. Differences in the Metabolism of Palmitic Acid and Linoleic Acid in Irradiated Animals. Morino, Y. (Okayama Univ., Japan). Okayama Igakkai Zasshi; 83: No. 11-12, 545-552(Dec 1971). (In Japanese).

After giving whole-body irradiation of 600 R, albumin complexed-palmitic acid-1-^{14}C or linoleic acid-^{14}C were administered to mice, and the changes of metabolism in these irradiated animals were studied. For this study, amounts of $^{14}CO_2$ exhaled, specific activity of liver lipids, and activities of individual fatty acid fractions with lapse of time were measured. It was found that the incorporation of palmitic acid-1-^{14}C into $^{14}CO_2$ was increased about 150% in the irradiated group as compared with that in controls. In contrast, that of linoleic acid-1-^{14}C was decreased by about 50% as compared with controls. The incorporation of palmitic acid-1-^{14}C into liver lipids was considerable in the early stage after the irradiation, but it decreased rapidly and became less than that of controls within a short period of time. The uptake of linoleic acid-1-^{14}C into the liver of the irradiated group was found to be decreased. In the irradiated groups, data revealed an inhibitory effect on unsaturation and chain elongation of both palmitic acid and linoleic acid. (auth)

10443 CHANGES IN RATIOS OF HIGH-MOLECULAR-WEIGHT FATTY ACID COMPOSITION, CONSTITUTING HEPATIC LIPIDS IN IRRADIATED ANIMALS. 1. Changes in Fatty Acid Biosynthesis in Irradiated Animals. Morino, Y.; (Okayama Univ., Japan). Okayama Igakkai Zasshi; 83: No. 11-12, 537-544(Dec 1971). (In Japanese).

In the experiments on fatty acid biosynthesis in vivo with mice given whole-body irradiation of 600 R using acetate-1-^{14}C, the amounts of $^{14}CO_2$ exhaled, specific activity of total lipids, and activities of each fatty acid fraction of the liver were studied. It was found that at early stage after irradiation the majority of acetate was utilized in oxidation and the part used in the biosynthesis was less in the irradiated animals than in controls. In these irradiated animals the biosynthesis of palmitoleic acid and stearic acid was relatively inhibited. (auth)

10444 CHANGES IN ATP METABOLISM IN X-IRRADIATED RAT THYMOCYTES. Araki, K. (Tokyo Women's Medical Coll.). Tokyo Joshi Ika Daigaku Zasshi; 42: No. 10, 725-737(Oct 1972). (In Japanese).

When animals are irradiated, the initial radiation damage to molecules in any type of cell is presumably similar. Yet, the manner in which cells die varies. Cell death can be divided into two classes, interphase death and reproductive death. The importance of interphase death in radiobiology is seen in its role in the radioinduced death of animals. There are probably three types of interphase death. To study the first type of interphase death, thymocytes and lymphocytes in vivo and in vitro are used. Lesions in ATP metabolism have been implicated in the mechanism leading to interphase death that occurs in thymocytes shortly after x irradiation. The author and her co-workers found the existence of lactate and fructose-1,6-diphosphate accumulation caused by enhanced glycolysis in the x-irradiated rat thymocytes and also found that ATP level was considerably decreased after irradiation, whereas ADP and AMP levels remained practically unchanged. This means that the degradation of the nucleotides proceeded beyond the level of nucleosides or purine-bases. Hypoxanthine began to be released into the extracellular medium in the early phase of 2 hrs' incubation at 37°C with glucose after irradiation. The amount was dependent on the x-ray doses ranging from 0.5 kR to 32 kR and may possibly explain the loss of the adenine nucleotides after irradiation. Addition of 5 mM adenine to 1 kR-irradiated rat thymocytes restored the ATP-content to normal level. Carbon-14-labeled adenine was incorporated into ATP and the ATP thus labeled degraded to hypoxanthine. Adenine in 5 mM concentration did not enhance the ATP synthesis from ^{14}C-adenine, but depressed markedly the degradation of ATP to hypoxanthine. It was concluded that restoration of the ATP level by adenine resulted from its depressive effect on degradation of adenine nucleotides. (auth)

10445 INHIBITION OF NEURON PRODUCTION BY X-RAY IRRADIATION. Nishimura, M. (Kyoto Prefectural Univ. of Medicine). Kyoto Furitsu Ika Daigaku Zasshi; 81: No. 9, 445-454(Sep 1972). (In Japanese).

Of various kinds of neurons, Purkinje cell was chosen as the target neuron for the present study. The majority of Purkinje cells in chick embryos were produced between 4 to 6 days of incubation, and that in mouse between 11 to 13 days of embryonic life. Two hundred R of x rays were administered to the chick embryos and pregnant mice at the stage of Purkinje cell production. Eight to 24 hrs after irradiation, many piknotic nuclei and nuclear debris were found in the matrix layer. Forty-eight hours later, however, the matrix layer was found to be completely recovered from the damage. Some animals, thus treated, were allowed to live until after birth and were sacrificed at the 20th day of age. The number of Purkinje cells in the 100 μ length at the Purkinje layer of these animals were counted to compare with that of control. The Purkinje cells in the cerebellum of irradiated mice were about 20% fewer in number for control mice. Morphological study on the Purkinje cells showed no abnormalities. (auth)

10446 CARDIOVASCULAR CHANGES AFTER A RADIOPROTECTIVE DOSE OF AET IN RATS. Kuna, P.; Smid, A. (Purkyne Medical Research Inst., Kralove, Czech.). Radiobiol. Radiother.; 14: No. 3, 311-318(1973).

Cardiac output and stroke volume decreased in pentobarbital anesthesized rats 10 and 20 minutes following AET · BrHBr (150 mg/kg i.p.) administration. Significant bradycardia was observed from the 2nd until the 9th minute post injection. The blood pressure was lowered during the first minute interval only. Peripheral resistance insignificantly increased following AET. No significant changes in the blood flow (estimated by ^{86}Rb method) occurred in radiosensitive tissues. (auth)

10447 METABOLISM OF 5-HYDROXYTRYPTOPHAN IN ISOLATED PERFUSED INTESTINE FROM NORMAL AND X-IRRADIATED RAT. Gerber, G. B.; Deroo, J.; Mazanowska, A. (CEN-SCK, Mol, Belg.). Arch. Int. Physiol. Biochim.; 80: 733-739(Oct 1972).

Metabolism of [^{14}C] 5-hydroxytryptophan (101 μg) was studied in isolated perfused intestine from normal and x-irradiated rats (24 hours after 2 kR, i.e., a dose causing death from the gastrointestinal syndrome after 3 days). The principal metabolite of 5-hydroxytryptophan is hydroxyindolacetic acid. In addition some 5-hydroxytryptamine and possibly glucuronides of 5-hydroxytryptophan, 5-hydroxytryptamine and 5-hydroxyindolacetic acid are formed. The rate of degradation of 5-hydroxytryptophan is diminished in x-irradiated rats (from 50 to 30 nmoles/h/g) and less 5-hydroxyindolacetic acid is formed. (auth)

10448 RECOLONIZATION OF THE SPLEEN AFTER AUTOTRANSPLANTATION OF SHIELDED MARROW IN THE IRRADIATED RAT. Ninkov, V.; Piletic, O.; Stojanovic, N.; Stepanovic, D.; Bradic, M. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Acta Anat.; 84: No. 4, 484-491(1973). (In French).

The recolonization of the irradiated spleen of rats with bone marrow shielded in situ during irradiation and autotransplanted immediately afterwards was investigated. Quantitative and histological analyses revealed that bone marrow shielded during irradiation, especially autotransplants of shielded bone marrow, stimulates regeneration in the spleen, with active hematopoiesis in the red pulpa. The histological findings clearly suggest that bone marrow has a stimulative effect on the activation of regenerative potential and is most effective after autotransplantation. (auth)

10449 LATE EFFECTS OF IRRADIATION ON THE THYROID GLAND IN MICE. 2. Irradiation of Mouse Foetuses. Walinder, G.; Sjoeden, A. M. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 11: No. 6, 577-589(Dec 1972).

The thyroid gland of mouse fetuses was irradiated by exposing the mothers on the 18th day of gestation to intravenous injections of ^{131}I, whole-body roentgen irradiation, or a combination of the two forms of radiation. The occurrence of thyroid tumors was investigated when the offspring had reached the age of about 2 years. The frequency of both benign and malignant thyroid tumors was high. As the aging thyroids of the unirradiated mice revealed adenomatous changes to an extent that had not been seen in earlier investigations the high frequency of tumors in the irradiated thyroids could not be attributed unequivocally to any special radiation sensitivity in the fetal glands. The significance of the growth factors in the development of radiation-induced thyroid neoplasms is discussed. (auth)

10450 RADIATION EFFECTS ON THE RESTING AND PROLIFERATING CELLS IN NORMAL TISSUE OF MOUSE. Hayashi, S. (Kyoto Prefectural Univ. of Medicine). Kyoto Furitsu Ika Daigaku Zasshi; 81: No. 10, 493-504(Oct 1972). (In Japanese).

The investigation was planned to compare the radiosensitivity of callus-forming cells in resting phase with that in proliferating phase and to compare the recovery of sublethal damage of callus-forming cells in resting phase with that in proliferating phase. Experimental animals were 8-week-old female I.C.R./J.C.L. mice. The maximum sizes of callus were nearly constant among control mice without irradiation after fracture. They, however, were inhibited with administered doses and seemed to be reflected by the proliferating ability of callus-forming cells after irradiation. The analysis was performed by C.I.D. 50 (callus inhibition dose 50) or dose that produced a specified inhibition of callus size in half of the subjects. The callus-forming cells in adult mice were in resting phase without any stimulations, but they extensively entered into proliferating phase after fracture. The labeling index rose around 6 hrs after fracture and reached 9% of the maximum value at 72 hrs after fracture. Mice were followed by x-ray projection until 60 days after irradiation to observe the callus sizes, and the maximum sizes of callus for each mouse were examined by planimetry to calculate the C.I.D. 50. The callus-forming cell was more radioresistant in resting phase by a factor of 1.5 to 2.0 than in proliferating phase. The cell in resting phase demonstrated a marked recovery of sublethal damage in 4 hrs after administration of 1,000 rads, and it showed essentially no more changes in recovery with the increased time interval to 24 hrs, while the cell in proliferating phase demonstrated almost full recovery of sublethal damage in 2 hrs after administration of 300 rads and showed a fluctuated pattern of recovery with a dip at 4 hrs of the time interval in two fractions. (auth)

10451 ALKALINE PHOSPHATASE IN THE INTESTINE OF THE MOUSE DURING RADIOINDUCED ATROPHY OF THE VILLI. Luz, A.; Goessner, W. (Gesellschaft fuer Strahlen und Goessner, W. (Gesellschaft fuer Strahlen und Umweltforschung mbH, Nuremburg). Beitr. Pathol.; 148: No. 2, 180-198(1973). (In German).

The radiation-induced change of the functional epithelium of the intestinal villi in the early postirradiation phase was studied by the histochemical demonstration of an alkaline phosphatase as a marker enzyme. Adult male mice received a single abdominal exposure to x irradiation of 1,200 rads. The animals were sacrificed between 1 and 10 days after irradiation. The histochemical demonstration of alkaline phosphatase with azo dye coupling techniques was applied to gross preparations of the formalin-calcium (5°C) fixed whole small intestine and to sections of the ileum. Alkaline phosphatase was simultaneously demonstrated with incorporated ^{3}H-thymidine in autoradiograms according to EDER. Macroscopic and microscopic specimens show a complete loss of alkaline phosphatase activity in the villus epithelium of the ileum between 3 and 4 days after irradiation. The epithelial cells of the villi that are devoid of alkaline phosphatase also are not labelled with ^{3}H-thymidine applied 1 hr before irradiation. The pattern of recurrence of enzyme active cells in the villi conforms to the pattern of cell regeneration observed with ^{3}H-thymidine in the crypts at 4 to 5 days after irradiation. Seven days after irradiation, the alkaline phosphatase reaction shows a normal picture in the ileum. (GE)

10452 MORPHOLOGICAL CHANGES OF THE MUCOUS MEMBRANE EPITHELIUM IN THE ORAL CAVITY IN ALBINO RATS OF DIFFERENT AGE AFTER ULTRAVIOLET IRRADIATION. Fedorova, L. V. (Medical Stomatological Inst., Poltava, USSR). Arkh. Anat., Gistol. Embriol.; 63: No. 10, 97-102(Oct 1972). (In Russian).

Cheek, tongue, and pallate epithelia were studied morphologically in 10 day, 3, and 12 month old albino rats with special reference to mitotic activity (MA) after irradiation by integral flow of uv spectrum. The doses of irradiation were 1.5, 3, and 10 min. Material was taken 24, 48, 72, and 120 hrs after irradiation. Multilayered cornifying epithelium of the oral cavity changed with age. The epithelium layer was thinnest in 10 day old animals, while in 3 month old ones it was thickest due to its high MA. Within 12 month of age, the epithelium tended to become thinner and the height of the connective tissue papillae grew lower. In the growth layer there was an increase of the amount of cells with pycnotic nuclei and vacuolized cytoplasm; in the granular layer there occurred accummulation of keratohyalin. MA decreased. Integral flow of uv rays during 1.5 min stimulated MA in the epithelia of all groups. Prolongation of the irradiation up to 10 min inhibited MA, induced disintegration of the growth layer, its partial exfoliation, and vacuolization of the cell cytoplasm. The epithelium of 3 month old animals proved to be most reactive due to its high MA under normal conditions as compared with the MA of 10 day and 12 month old animals and hence the youngest cells of the growth layer. (auth)

10453 FOCAL STIMULATION OF THE BRAIN BY ENTIRELY EXTRACRANIAL MEANS. An Example of Radiation Controlled Focal Pharmacology. Remler, M. P. (Univ. of North Carolina, Chapel Hill). Confin. Neurol.; 35: 50-62(1973).

A method for focal stimulation of the brain by entirely extracranial means is presented. A focal x ray lesion of cortex was made that reduces the blood-brain barrier in that area. Then parenteral penicillin was administered. Penicillin is primarily confined to the vascular space by the blood-brain barrier in all parts of the brain except for some leakage into the brain at higher doses. An increased concentration of penicillin is created in the irradiated cortex. The penicillin creates a focal epileptic lesion in the irradiated area. This is an example of radiation-controlled focal pharmacology in the central nervous system. (auth)

10454 RECENT PROGRESS MADE IN RADIATION BIOLOGY OF FAST NEUTRONS. Sztanyik, L. B. (International Atomic Energy Agency, Vienna). pp 23-36 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

Interest in biological effects of neutrons has increased rapidly during the past 10 to 15 years as a result of new developments in neutron technology and encouraging achievements in the practical applications of neutrons in medicine, agriculture, and some other disciplines. In particular, a rapid accumulation of knowledge has taken place in cellular radiation biology. It has been demonstrated that dose-effect curves for neutrons and mammalian cells are more nearly exponential than those for γ or x rays, and have little or no shoulder. The relative biological effectiveness (RBE) of fast neutrons in cell killing is a function of dose, dose-rate, dose-fractionation, energy of neutrons, oxygenation of cells, genetically determined radiosensitivity of the cell-line, age of cells in the cell-cycle, end-point observed, etc. RBE for non-lethal damage is generally not significantly different from that for cell killing. On the other hand, high RBE values have been reported for neutrons at low doses for long-term effects and mutagenicity in mammals. (auth)

10455 HEMOPOIESIS IN RATS IN GENERAL EXTERNAL β IRRADIATION. Zhil'tsov, I. F.; Molchanova, M. G. Med. Radiol.; 18: No. 11, 41-43(Nov 1973). (In Russian).

In white rats treated with a single dose of 3000 rads of beta radiation (^{85}Kr) plus 400, 250, or 50 R of x radiation, the skin of exposed parts of the spine showed an increased free-oxygen content on the 7th and 14th days and a decreased content on the 21st and 28th days. No change was observed after 250 rads of beta plus 50 R of x radiation. The increased oxygen tension is considered to be caused chiefly by the x radiation and the decrease by the increase in gas exchange due to development of the initial stages of a radiation dermatitis resulting chiefly from beta irradiation of the skin. (TTT)

10456 LIVER FUNCTION TESTS ON ANIMALS WITH RADIONUCLIDES AFTER AIMED ^{60}Co-IRRADIATION. Brase, A.; Bockslaff, H.; Haindl, H.; Jaervinen, S. (Medizinische Hochschule, Hanover). Strahlentherapie; 146: No. 2, 198-207(1973). (In German).

After single aimed irradiation of the total liver with ^{60}Co in animal experiments on New Zealand rabbits, the radio-reaction of the two liver-cell systems was tested by function scintigraphy, after i.v. application of radio-gold colloid and iodine-131-bromosulfophthalein. A decreased vitality of the RES of the liver was found from 800 rad TD, a functional lesion of the liver parenchyma was observed from 1,000 rad TD. The degree of the functional impairment increased in relation to the applied dose. Within a few weeks after irradiation, it came to normalization of the observed functional changes in the survivant rabbits; this proved the good regeneration-capacity of the liver. (auth)

10457 DIFFERENTIAL SPLIT-DOSE RADIATION RESPONSE OF RESTING AND REGENERATING HEMOPOIETIC STEM CELLS. Hendry, J. H. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 5, 469-473(Nov 1973).

Hemopoietic stem cells were less sensitive to killing by a dose of radiation, if it were delivered in two fractions separated in time. The magnitude of this decrease in sensitivity was greater when the cells were irradiated in the normal steady state, compared with a regenerating state. However, the effect was reversed when donor mice received two radiation doses, separated in time by 24 hrs, and this was said to be due to effects (on differentiation and on proliferation) occurring between the first and second doses. These observations are discussed in relation to the therapeutic practice of daily dose treatments. (auth)

10458 ATROPINE-CAUSED CENTRAL NERVOUS SYSTEM INTERFERENCE WITH RADIATION-INDUCED LEARNED AND UNLEARNED BEHAVIORS. Gould, M. N.; Yatvin, M. B. (Univ. of Wisconsin, Madison). Int. J. Radiat. Biol.; 24: No. 5, 463-468 (Nov 1973).

The inhibition by atropine of radiation-induced conditioned saccharine aversion (RCSA) and unconditioned bizarre eating in the rat was investigated. Atropine sulphate interfered with the two behavioral responses, but atropine methylnitrate did not. This supports the conclusion that the central nervous system is the site of atropine interference. Furthermore, RCSA was inhibited when atropine sulphate was given either before or after irradiation and conditioning, indicating that the presence of the drug during the acquisition of RCSA was not necessary for this behavioral blockage. (auth)

10459 CLONOGENIC CELLS AND STEM CELLS IN EPIDERMIS. Potten, C. S.; Hendry, J. H. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Int. J. Radiat. Biol.; 24: No. 5, 537-540(Nov 1973).

A model for epidermal proliferation of a subpopulation of clonogenic cells is briefly discussed and tested in relation to published results of fractionated irradiation survival for mouse epidermis. It is suggested that since the computed average values for the initial number of clonogenic cells differ by an order of magnitude for the measured values for basal cells in mouse skin, one in ten of the basal cells might be clonogenic. It is pointed out that this explanation is compatible with the observation of hexagonal epidermal units, the central stem cell cycling at a slower rate than the rest. (UK)

10460 RADIATION INJURY OF CONNECTIVE TISSUE. A Biochemical Investigation with Experimental Granuloma. Rantanen, J. (Turku Univ., Finland). Acta Radiol., Suppl.; No. 330, 1-92(1973).

The effects of radiation injury on the repair process of connective tissue in subcutaneous experimental granulation tissue (induced by viscose cellulose sponge in rat) were studied. Single local exposure to 1000 rad (250 kV roentgen rays) was given at the phase of mobilization-migration (3rd post implantation day), at the phase of proliferation (7th day) or at the phase of collagen synthesis (15th day). The chemical composition of granuloma was analyzed at predetermined intervals up to the beginning of the phase of involution (30th day, or in some cases up to the 60th day). Changes in the collagen content of granulation tissue were correlated with changes in the tensile strength of skin wound, irradiated at corresponding phases. Radioinduced effects on the solubility of collagen in granuloma irradiated in vitro in the dry or wet state and in a nitrogen or oxygen atmosphere were compared to those observed after exposure in vivo. The effect of breathing 100% oxygen during irradiation in vivo was also investigated. The dose-response of tissue was followed by exposing 7-day-old granuloma to doses from 100 to 6000 rad and by analyzing it up to the 33rd day. The biochemical mechanism of radiation induced effects on granuloma was examined by in vivo or in vitro incorporation experiments with ^{3}H-thymidine (synthesis of DNA), ^{3}H-cytidine (synthesis of RNA), ^{3}H-proline (synthesis and degradation of collagen and noncollagenous proteins), and with ^{35}S-sulphate (synthesis and degradation of sulphated glycosaminoglycans). (SW)

10461 MICROFRACTIONATION. A Particular Type of Pulsed Irradiation in the Treatment of Mammary Tumors in C_3H Mice. Stone, J.; Cheshire, P. J. (St. Bartholomew's

Hospital, London). Acta Radiol., Ther., Phys., Biol.; 12: No. 1, 71-80(Feb 1973).

Pulsed irradiation with 5 sec intervals was compared with conventional continuous irradiation in C_3H mice with transplanted mammary tumors. There was no difference between the two methods at the therapeutic dosage level in mice of 4500 rad in a single dose. This was not so at the low dose level of 1500 rad which was significantly in favor of pulsed irradiation and which is to be further investigated. (auth)

10462 COMPARISON OF CHROMOSOME ABERRATION YIELDS IN RABBIT BLOOD LYMPHOCYTES IRRADIATED IN VITRO AND IN VIVO. Clemenger, J. F. P.; Scott, D. (Medical Research Council, Harwell, Eng.). Int. J. Radiat. Biol.; 24: No. 5, 487-496(Nov 1973).

The frequency of dicentric chromosome aberrations in cultured rabbit blood lymphocytes given 300 to 600 rads ^{60}Co gamma radiation was the same whether the blood was irradiated in vitro or in vivo. Periodic adjustment of pH was found to be critically important for success with cultures of rabbit blood. (auth)

Invertebrates

10463 APPLICATION OF RADIATION-INDUCED TRANSLOCATIONS FOR GENETIC CONTROL OF AEDES AEGYPTI. Rai, K. S.; McDonald, P. T. (Univ. of Notre Dame, IN). pp 77-94 of Genetics and Our Health. New Delhi; Indian Council of Medical Research (1972).

From proceedings of the seminar on genetics and our health; New Delhi, India (5 Apr 1971).

Genetic sterility associated with chromosomal translocations induced by radiation was investigated in the yellow-fever mosquito Aedes aegypti with a view to applying it as a method for genetic control. Two advantages of this method over the sterile male technique are that continued reintroductions of sterile males are not necessary to maintain control and the competitive ability of translocated insects may not be hampered as the translocation systems are usually associated with an essentially unaffected genotype and phenotype. In the studies undertaken, the linkage groups in most of the translocations were identified and translocation break points were localized. The translocated males showed competitive mating ability in single pair, in laboratory, and outdoor population cages. The theoretical potential of the use of various types of translocations already available in Aedes aegypti was investigated with computer simulations under various release strategies. This investigation indicated a potential role of translocation heterozygotes for an insect population characterized by population growth five-fold per generation or less. Further plans to assess the feasibility of the translocation method for population control of Aedes aegypti on a small scale field trial are outlined and cautions to be exercised in such trials are indicated. (INIS)

10464 GENETIC CONTROL OF MOSQUITOES: PROGRAMME OF THE WHO/ICMR COLLABORATIVE RESEARCH UNIT. Smith, C. N. pp 120-122 of Genetics and Our Health. New Delhi; Indian Council of Medical Research (1972).

From proceedings of the seminar on genetics and our health; New Delhi, India (5 Apr 1971).

The program of the WHO/ICMR (World Health Organization/Indian Council of Medical Research), Research Unit on the genetic control of mosquitoes, New Delhi, India, is briefly outlined. Genetic methods for the control of mosquitoes that are assessed are the sterile male technique; the release of males of a strain that are cytoplasmically incompatible with the local strain; and the release of males of a strain bearing one or more translocations in the chromosomes. The translocation is brought about by radiation exposure. Practical problems to be solved during the investigatory studies are indicated. (INIS)

10465 EFFECTIVENESS OF CHEMOSTERILANTS AND GAMMA RADIATION IN THE STERILIZATION OF THE TROPICAL HOUSE-MOSQUITO CULEX FATIGANS. Sharma, V. P. (Indian Council of Medical Research, New Delhi). pp 129-134 of Genetics and Our Health. New Delhi; Indian Council of Medical Research (1972).

From proceedings of the seminar on genetics and our health; New Delhi, India (5 Apr 1971).

Studies on effectiveness of chemosterilants and gamma radiation in sterilization of the tropical house-mosquito, Culex fatigans are reviewed and the two methods are comparatively evaluated. The principal disadvantage of the method using radiation-induced sterility is a reduction in mating competitiveness, mating ability, and longevity of the radiation-sterilized mosquitoes. Out of the chemosterilants so far studied, tepa and metepa were found to have an excellent sterilizing effect on adults when exposed to their residues, but they are poor pupal sterilants for Culex fatigans. Delhi strain of Culex fatigans was found to be more sensitive to thiotepa in pupal stage for inducing sterility. (INIS)

10466 EFFECTS OF X IRRADIATION ON THE TOXICITY OF ORGANOPHOSPHATE INSECTICIDES TO THE HOUSE FLY. Drake, J. L.; Crowder, L. A.; Ware, G. W. (Univ. of Arizona, Tucson). Pestic. Biochem. Physiol.; No. 1, 373-380(1971).

Dosage-mortality tests for 29 selected organophosphate insecticides were conducted on male and female control and x-irradiated house flies, Musca domestica L. Twenty of the insecticides exhibited no significant toxicity change in irradiated flies. X-irradiation induced significantly increased or decreased toxicities for nine of the insecticides tested. Five insecticides were significantly less toxic to irradiated males than to irradiated females. Electrophoretic analysis of control and x-irradiated male and female fly homogenates showed no qualitative differences in the banding patterns for general proteins, α-naphthyl esterases, and alkaline phosphatases; however, the possibility of quantitative differences in some bands is not excluded. X-ray altered genome sites and microsomal induction by x-irradiation are discussed. Although speculative, microsomal induction appears to be responsible for the toxicity changes observed. (auth)

10467 EFFECT OF NITROGEN DURING γ IRRADIATION OF PUPARIA AND ADULTS OF THE MEDITERRANEAN FRUIT FLY ON EMERGENCE, STERILITY, LONGEVITY, AND COMPETITIVENESS. Wakid, A. F. M. (International Atomic Energy Agency, Vienna). Environ. Entomol.; 2: No. 1, 37-40(Feb 1973).

When males of Ceratitis capitata (Wiedemann) were irradiated either in the late pupal (2 days before eclosion) or the adult stage (1 to 24 hours old) with 7, 9, and 11 krad in air and in nitrogen, exposure to nitrogen before and during irradiation decreased sterility. No significant differences in sterility were found among nitrogen exposure periods of 5, 15, 25 or 35 minutes before irradiation. Adult longevity decreased with increasing radiation dose regardless of whether the adults or pupae were irradiated in air or nitrogen. However, at any of the doses, individuals irradiated in nitrogen as pupae were longer lived than comparable pupae irradiated in air. By contrast, those irradiated in nitrogen as adults lived as long as when irradiated in air. Competitiveness of males irradiated as adults in nitrogen atmosphere was higher than that for males irradiated in air, but the differences were not statistically significant. Males irradiated as pupae in nitrogen were significantly more competitive than those irradiated in air. Differences between competitiveness of males irradiated in air as pupae and males irradiated as adults were not significant. In contrast, when irradiation was applied in nitrogen atmosphere, competitiveness of males irradiated as adults was significantly less than that of males irradiated as pupae. (auth)

10468 AGE-DEPENDENT CHANGES OF RADIOSENSITIVITY IN EMBRYO OF BOMBYX MORI. Murakami, A. (National Inst. of Genetics, Mishima, Japan); Miki, M. J. Radiat. Res.; 13: No. 4, 183-192(Dec 1972).

The changes in radiosensitivity during embryogenesis of the silkworm, Bombyx mori L., were investigated. The radiosensitivity expressed as $LD_{50}(R)$ values was estimated from the dose hatchability curves obtained following irradiation with x rays and ^{137}Cs γ rays. Data obtained in the present study together with results previously reported indicated that the radiosensitivity generally decreased as the embryonic development proceeded and that the age-dependent change in radiosensitivity may strongly depend on the degree of morphogenesis. From the viewpoint of the marked differential stage sensitivity, the process of embryogenesis may be divided into two main phases: one is a sensitive phase which corresponds to the time prior to and during blastokinesis (or before the completion of the embryonic morphogenesis) and the other is an extremely resistant phase which corresponds to the stage after blastokinesis. The former embryo was about 10 times as high in radiosensitivity as the latter embryo. (auth)

10469 EFFECTS OF POST-IRRADIATION INCUBATION ON THE FIBROIN SYNTHETIC ACTIVITY OF SILKGLAND RIBOSOMES. Kobayashi, T.; Matsumoto, K.; Yoshii, G. (Hokkaido Univ., Sapporo). J. Radiat. Res.; 13: No. 4, 214-220(Dec 1972).

Isolated silkgland ribosomes were irradiated with x rays from 570 to 4600 R, and their ability to synthesize fibroin in vitro was examined. A marked decrease in their activities was observed when ribosomes were incubated at 37°C following x irradiation. Per cent decrease in the ribosomal activity leveled off at 37°C after 30 min incubation. The extent of decrease was dependent on x-ray dose. Treatment of ribosomes with pancreatic ribonuclease showed a decrease in the ribosomal activity. These results suggest that a type of radiation damages on irradiated ribosomes is likely to be revealed during the post-irradiation

incubation period through a possible interaction with ribonuclease either activated or released by x irradiations. (auth)

Radionuclide Effects (Internal Source)

Man

10470 (ORNL-4903, pp 115-118) ESTIMATION OF DOSE AND DOSE COMMITMENT TO THE BLADDER WALL FROM A PHOTON EMITTER PRESENT IN URINE. Snyder, W. S.; Ford, M. R. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Computer calculations were made of the radiation dose to the bladder wall from photons of various energies emitted by 12 radionuclides in the urine. The effects of urinary output and number of voids per day on the dose received by the bladder wall were also calculated. Results of the study suggest that the dose to the bladder wall may be significantly reduced if the fluid intake of the patient can be increased throughout the period of radionuclide excretion and that a further reduction may be secured if the radionuclide is administered when the bladder is approximately half full. (CH)

10471 (ORNL-4903, pp 119-124) DOSE FROM PHOTON EMITTERS DISTRIBUTED UNIFORMLY IN THE TOTAL BODY AS A FUNCTION OF AGE. Hilyer, M. J. C.; Hill, G. S.; Warner, G. G. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Estimates were made of the radiation dose rate and dose absorbed by various human organs and tissues as a function of age from six radionuclide photon sources ranging from 20 keV to 2 Mev distributed uniformly in the body. The estimates were made by means of Monte Carlo techniques and computer calculations in tissue-equivalent human phantoms reduced by scale factors to represent newborn infants and individuals aged 5, 10, 15, and 20 years. It was assumed that the dose rate in the target organ is proportional to the specific absorbed fraction (SAF), defined as that fraction of the energy emitted which is absorbed per gram of the target organ, with the whole body considered the source and any organ, including the total body, considered as the target organ. (CH)

10472 (ORNL-4903, pp 125-129) ESTIMATES OF DOSE RATE TO GONADS OF INFANTS AND CHILDREN FROM A PHOTON EMITTER IN VARIOUS ORGANS OF THE BODY. Snyder, W. S.; Ford, M. R. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Estimates were made of the radiation dose rates to the gonads of infants and children from radioisotope photon sources distributed uniformly in various organs of the body. Estimates were made for photon energies of 0.02, 0.05, 0.1, 0.5, 1.0, and 2 MeV using Monte Carlo techniques and computer calculations in tissue-equivalent human phantoms reduced by scale factors to represent infants and children. (CH)

10473 ANALYSIS OF THE RADIOLOGICAL RISKS ASSOCIATED WITH AN INCIDENT OF THE RUPTURE OF TEST TUBES CONTAINING SAMPLES IRRADIATED IN THE POWDER STATE. Di Palo, L.; Moccaldi, A.; Scelfo, A. Ing. Nucl.; 13: No. 4, 26-28 (1972). (In Italian).

The radiation risks to personnel associated with the breaking of a test tube containing samples in the powdered state irradiated in the RC-1 reactor at 1 MW are evaluated. The data are used to estimate the radiation dose to personnel present in the reactor room. (tr-auth)

Animals

Refer also to abstracts 10449 and 10504.

10474 EFFECT OF INTERNAL IRRADIATION ON FISH. Eto, K. (National Inst. of Radiological Sciences, Chiba, Japan). pp 298-316 of Radioactivity and Fishes. Contamination, Injuries, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

Experimental cases in which the effects of various nuclides from low concentrations of radioactive waste accumulated in the body of fish are reviewed. Many fishes (killfish, goldfish, chasmichthys gulosus, fish in brackish water) were easily obtained as experimental subjects. Nuclides were P, Ca, Co, Sr-Y, Ru, I, Cs, and Pu. The characteristic internal irradiation by various nuclides in the body was long-term irradiation at low doses. Even in animals in the same area, if the local ecological condition differed, the degree of disturbance was changeable. In experiments on hematopoietic systems of adult fish, a rainbow trout continuously received $^{90}Sr-^{90}Y$. In the group with 0.5 $\mu Ci/g$ weight, there were a check of growth and an increase of mortality. In addition, a decrease of white corpuscles was observed. In Heteropneustes fossils bred in ^{32}P, there was a blood change in which the numbers of both red and white corpuscles were lowest after 4 to 5 days. When the effects of low concentrations of radionuclides were studied, it was possible to make the genital gland a main critical organ. Effects of ^{131}I on the thyroid gland were determined. Radiosensitivity was higher for the occurrence rate of malformations than for the hatching rate. The radiosensitivity of the occurrence of fetus was high. $^{90}Sr-^{90}Y$ was about 10^{-10} Ci/l, and there was a significant increase in abnormal occurrence rate. From the experiment by Polikarpov and Lvanov, a correlation was observed between the quantity of ^{90}Sr and the occurrence rate of abnormal young fish. The absorbed dose in the body consisted of dose from various nuclides deposited in the body (D_{int}) and dose of external radiation from the environment of living animals (D_{out}). Absorbed dose (D) was calculated from $D = D_{int} + D_{out}$ in Loevinger formula. From the genetic aspect, various nuclides seemed not to have an influence on the individual itself, but it became evident that they had an influence on the reproduction of individuals. (JA)

10475 ALTERATIONS IN THE BLOOD SYSTEM OF DOGS IN THE CASE OF ^{241}Am INHALATION. Kudasheva, N. P. pp 312-315 of Biol. Deystviye Vneshnikh i Vnutren. Istochnikov Radiatsii. Moscow; Meditsina (1972). (In Russian).

In dogs subjected to a single inhalation effect of ^{241}Am-nitrate (pH 1.5 to 2.0), the deposition of ^{241}Am in the lungs amounted to 1 to 2 μ curies (first group), 4 μ curies (second group), 5 to 7 μ curies (third group), and 8 to 10 μ curies (fourth group). A study of the peripheral blood for 12 months demonstrated that against the background of absence of variations in the number of erythrocytes, reticulocytes, and Hb, the total number of leucocytes dropped (basically as a result of the neutrophils). The greatest alterations were detected in the fourth group where the number of leucocytes dropped to 400 cells per mm^3, and the number of thrombocytes dropped. In the bone marrow of the dogs in the second, third, and fourth groups, a reduction in the absolute number of myelokaryocytes was noted. In all groups, an increase in the mitotic activity of the cells of the red series was observed. Histologically, for two dogs that died in 116 to 414 days, pneumonia and pneumosclerosis with hypoplasia of the bone marrow were detected. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstracts 10143 and 10146.

Man

Refer also to abstracts 10470, 10504, 10546, 10547, 10549, and 10577.

10476 (BNWL-1764) RADIOLOGICAL EVALUATIONS FOR ADVANCED WASTE MANAGEMENT STUDIES. Denham, D. H.; Baker, D. A.; Soldat, J. K.; Corley, J. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 79p. Dep. NTIS $5.45.

The overall risk evaluation for various radioactive waste management concepts includes calculation of radiation doses to individuals and local populations. Radiation doses are the most appropriate measure of the consequences of unforeseen releases of radioactive materials to the environment and dose criteria are available by which the severity may be judged. A comprehensive dose computational model, developed and used for other Atomic Energy Commission studies, has been adopted to improve its flexibility and to assist in evaluating alternative means for disposal of high-level waste. Typical input terms for normal use include source terms (radionuclide release rates to man's immediate environment) and dilution factors. Outputs include individual pathway doses and total doses to maximum individuals for both an urban and a rural population. Whole-body doses plus doses to other critical organs are obtained, as well as the fractional dose contributions of individual nuclides. Doses for one year or total doses for fifty years of exposure are available. Although all of the many factors and assumptions used can be changed if desired, listings of those currently being used are given. Factors used are for the most part from recognized sources, supplemented by local data and assumptions as necessary. For doses to individuals, dietary and living habits are postulated which will tend to maximize the doses which might occur from potential release modes. Examples of dose calculations are included to demonstrate use of the methodology for a

hypothetical geological disposal concept, with direct release to man's immediate environment after storage periods ranging from 100 to 1,000,000 years. The most significant nuclides in terms of dose will vary with time and mode of release, but are likely to be ^{90}Sr and ^{137}Cs at 100 years, americium and plutonium at 1,000 to 10,000 years, and uranium daughters at longer periods. (auth)

10477 (ORNL-4903, pp 130) HUMAN METABOLIC MODEL FOR ^{14}C-LABELED METABOLITES USEFUL IN DOSE ESTIMATION. Bernard, S. R. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

A metabolic model for carbon was developed for use in estimating the radiation dose to human tissues following the administration of tracer doses of ^{14}C-labeled metabolites. The model is based on the assumption that an average 70-kg man takes in some 350 g of carbon per day, and that his total body content of carbon is about 14 kg, with a mean residence time of 40 days. (CH)

10478 ABSOLUTE UPTAKE OF STABLE IODINE BY THE THYROID IN STUDIES OF BASEDOW'S DISEASE. Mornex, R.; Berthezene, F.; Chavrier, B. (Univ., Lyon). pp 356-363 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; 9 Jun 1972 (9 June 1972).

Measurement of % iodine uptake as a function of time is one of the most frequently used parameters in thyroid explorations. If a quantitative result is to be obtained, it is necessary to know the ratio between the quantities of stable and radioactive ions. The results concerning 300 tests carried out on 220 individuals comprised of persons suffering from Basedow's disease and normal individuals are analyzed. (FR)

10479 DOSE EQUIVALENT DETERMINATION IN THE CASE OF INTERNAL CONTAMINATION BY TRITIATED WATER. Kollar, J. (Research Inst. of Industrial Hygiene and Occupational Medicine, Bratislava); Merjavy, S. Jad. Energ.; 19: No. 7, 220-226(1973). (In Czech).

The current methods for determination of tritium content in man are based on measuring of tritium concentrations in the body liquids (urine, exhaled vapor, saliva, sweat, etc.). Precise determination of tritium amounts in the human body is possible if the measurement is made sooner than several weeks after contamination, and requires the knowledge of individual biological half-time. In routine survey the determination of the dose equivalent is based on periodical measurement of tritium concentrations in urine and the time of the intake event is assumed. The accuracy of the dose equivalent assessment depends on the time interval between two consecutive measurements and on the individual half-time of tritium excretion. In case of repeated tritium intakes, the reliability of the dose equivalent evaluation depends on the ratio between tritium concentrations of two consecutive measurements. The tabulated values are presented for use in the estimation of the limits and the average value of dose equivalent received by the critical organ during chronic exposure. (auth)

10480 SPECTRAL REGION ASSESSMENT OF THE INFLUENCE OF THYROID DEPTH ON THYROID RADIOIODINE UPTAKE. Wellman, H. N.; Tieman, J.; Saenger, E. L. (Univ. of Cincinnati). pp 135-148 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

This paper describes a sensitive technique for thyroid radionuclide uptake measurements based on the use of detectors with large field of view placed in contact with the neck of the subject. The technique depends on correction of the measurements for variation in detector-to-thyroid distance, which is estimated in terms of the photo-peak to scatter ratio of the pulse-height spectrum of the scintillation detector pulses, the observed ratios being compared with those found in measurements on phantoms with thyroids at different depths. Two variants of the technique, one using a single-detector and the other using a dual-detector system are described. The results of comparative experimental studies of these techniques and the ORINS standard technique in ^{131}I and ^{123}I uptake measurements are presented. These indicate that the single-detector technique offers an increase in sensitivity of about 20 times and the dual-detector technique an increase of 300 to 500 times as compared with the ORINS technique with a concomitant increase in accuracy resulting from the inclusion of a correction for variation in the depth of the thyroid. The dual-detector technique is shown to offer particular promise for ^{123}I uptake measurements. A protocol for comparative studies of thyroid radionuclide uptake measurement techniques based on measurements on terminal patients is described and results obtained on a single patient presented. (auth)

10481 LONG-TERM EXCRETION AND RETENTION OF AN INTRAVENOUS DOSE OF ^{45}Ca IN TWO HEALTHY MEN. Carr, T. E. F.; Harrison, G. E.; Nolan, J. (Medical Research Council, Harwell, Eng.). Calcified Tissue Res.; 12: No. 3, 217-226(1973).

The retention of ^{45}Ca was determined up to 388 days after an intravenous injection by measuring the urinary and fecal excretions and correcting for the loss from the skin. In the two healthy men examined, the urinary excretion rates were very similar but the fecal excretion rates differed by a factor of two. Retention expressed as dose minus excretion followed a power law after the first 4 or 7 weeks but at earlier times an additional exponential term was necessary to account for the data. Plasma concentrations of the dose were measured up to 15 days after the injection. The renal clearances for the two subjects were not significantly different. (auth)

10482 APPLICATION OF AUTORADIOGRAPHY TO STUDIES OF INTERNAL IRRADIATION WITH SPECIAL REFERENCE TO Pu. Kashima, M. (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 16: No. 6, 111-115(Jun 1973). (In Japanese).

As well as exploring the problem of injury due to internal irradiation, the role of autoradiography in its studies was discussed with special reference to Pu. In the experiment of internal irradiation, there are many factors to be considered, e.g., nuclides, the route of invasion, and deposited tissues, for accurate evaluation of the exposure dose for the vital body that changes in time and space should be added to those factors for examination. Although the effect attributed to the mutation of one of about 10^{14} cells in the human body, i.e., carcinogenesis, is discussed at the tissue level at present, quantitative analysis of activity and observation of the nonuniform distribution of radioisotopes in tissues are required for a more correct evaluation. Autoradiography being used for that purpose is one of the measuring methods of radiation where the formula of contribution of energy from radiation to substance is visualized and is recorded using photographic emulsion. Nonuniformity factor is used as the coefficient showing the distribution and nonuniformity of radionuclides in the tissues and is obtained by dividing the concentration at the site in question in the tissues (c) by the mean concentration of the nuclide in the pertinent tissues ($\bar{c}$), namely $c/\bar{c}$. In regard to the autoradiography with bone-seeking nuclides, the modified studies of preparation of bone specimens by Jee et al. were introduced. The autoradiography in the experiment of Pu exposure by inhalation was demonstrated. (JA)

10483 INTERNAL RADIATION EXPOSURE. Okabayashi, H. (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 15: No. 9, 165-170(Sep 1972). (In Japanese).

The internal exposure to radioactive aerosols, in particular in the human respiratory system, with reference to the data obtained by the International Commission on Radiological Protection (ICRP) is discussed. Although internal exposure can usually be detected by a detection device externally, radioactivity is only estimated by bioassay of excreted or secreted substances in case of beta-emitters and alpha-emitters. In the previous experiment using rats that received plutonium nitrate aerosols by inhalation, the rate of retention of radioactivity in the rat lung was 60% of the aerosol loaded in the inhaled air. Plutonium was observed in rat blood right after inhalation, and Pu excretion in the feces was 10 to 40 times that in the urine; one half of the total aerosol inhaled was excreted after 2 days. After investigation of excretion rates of $BeSO_4$ and $Zn(NO_3)_2$ aerosols inhaled by rats, it is concluded that the excretion rate in the urine and feces differs according to the type of radionuclides and at the same time the retention rate of radioactive aerosols is influenced by route of intake. It is necessary to establish coefficients to estimate internal retention from the excreta in future studies. (auth)

10484 CLINICAL USE OF WHOLE-BODY RADIOMETRY TO STUDY ^{24}Na METABOLISM. Palinkashi, D. G.; Ryskulbekov, A. U. (Moscow Medical Inst.). Radiobiologiya; 13: 132-133 (Mar 1973). (In Russian).

Twenty-four hours after oral administration of ^{24}Na to patients with a decreased blood circulation rate, the amount excreted was about 22% of that excreted by healthy controls. Amounts retained by the blood and by other tissues (as determined by whole-body counting) were about 13 and about 120%, respectively, of the values in the controls. Two hours after the ^{24}Na was administered, practically all of it was in the blood in both controls and patients. (TTT)

10485 STRONTIUM-90 IN DECIDUOUS TEETH COLLECTED IN NORTHERN FINLAND FROM CHILDREN BORN IN 1952–1964. Rytoemaa, I. (Univ. of Helsinki). Acta Odontol. Scand.; 30: No. 2, 219-233(May 1972).

Strontium-90 content was measured by means of Cerenkov radiation in deciduous teeth collected in three areas in northern Finland from children born in 1952 to 1964. The ^{90}Sr levels in tooth crowns in areas I and II showed a continuous increase in children born in 1952 to 1958, no further increase during the years 1959 to 1961, a sharp increase in 1962 to 1963, and no further change in 1964. In the northernmost part of Finland (area III) the ^{90}Sr contents of deciduous teeth when plotted against year of birth showed a slightly different trend with no increase during the years 1952 to 1957 and a steep rise in 1958 and 1959. These changes occurred in both Lapp and non-Lapp children. These differences in the ^{90}Sr content of deciduous teeth were presumably related to environmental peculiarities and specific dietary habits in area III. The maximum ^{90}Sr level, 16.76 pCi/gCa, was found in a sample of tooth roots of four Skolt children born in 1963. The ^{90}Sr contents in the crowns of the four types of deciduous teeth were related as follows: second molars > cuspids > first molars > incisors. (auth)

Animals

Refer also to abstracts 10147 and 10356.

10486 (CEA-CONF-2252) VARIATIONS IN THE CONCENTRATION FACTOR OF ^{60}Co IN THE MUSSEL, MYTILUS EDULIS L. Amiard, J. C.; Le Lannou, M. (CEA Centre de La Hague, 50 – Cherbourg (France)). [nd]. 3p. (In French). (CONF-721146-1). Dep. NTIS (U. S. Sales Only) $3.00.

From twenty-third meeting of the International Commission for Scientific Exploitation of the Mediterranean Sea; Athens, Greece (3 Nov 1972).

Mussels, collected at various times during the year, were placed in aquariums operating in closed circuit in a room kept at 14 to 16°C. Solutions of ^{60}Co in HCl were added to the aquariums and the mussels were introduced in the contaminated medium when the radioactivity of the water was stabilized. Under the experimental conditions used the radiocobalt introduced in the cation form evolved toward the anion form. The radioactivity of the flesh and the shells of the mussels was measured separately with the aid of a multichannel analyzer. The results were expressed in concentration factor with respect to the water. An increase of the concentration factor of the meat was noted when the concentration level of the water passed from 1 to 7 μCi/l. A lower content was found for the shell than for the meat. (JSR)

10487 (CEA-CONF-2253) USE OF INHALED AND INGESTED LEAD AS A METABOLIC MODEL IN RADIOTOXICOLOGY. Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 6p. (In French). (CONF-721094-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international symposium on the environmental health aspects of lead; Amsterdam, Netherlands (2 Oct 1972).

The reasons for the development of metabolic models for radiation protection studies are analyzed and the bases on which these models are established are discussed. A lung model is described and the methods by which each of the parameters can be varied are described. Applications to lead metabolism following inhalation or ingestion are discussed. (tr-auth)

10488 RADIOLOGICAL STUDIES ON THE EFFECTS OF CADMIUM CHLORIDE IN ALBINO RATS. Kamoi, K. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 91: 1-34(Jan 1972). (In Japanese).

Subcutaneous injection of cadmium chloride into rats was carried out every three days, at doses of 1, 5, 50, 100, and 200 ppM to cause acute cadmium intoxication. Changes of body weight in comparison with the control group were observed. Furthermore, in order to study bone mineral metabolism, uptakes of ^{47}Ca in the liver, kidney, spleen, muscle, blood, femur, and jawbone were surveyed and autoradiograms with ^{45}Ca were prepared. As compared with the control group, administration groups of 1 and 5 ppM of cadmium gave a curve of increase in body weight. In concentration groups above 50 ppM a curve of increase in body weight was suppressed. The uptake of ^{47}Ca by each organ and bone system was gradually suppressed with an increase of cadmium concentration and was classified into two types with its course. In type 1, a gradual decrease with an increase of concentration of cadmium was noted. The liver, kidney, muscle, femur and jawbone belonged to this type. In type 2, the uptake of ^{47}Ca shows a rapid fall, even if a very small concentration of cadmium was noted. The spleen and blood belonged to this type. On microradiogram and autoradiogram, the bone became somewhat compact after administration of low concentration of cadmium, giving the appearance of osteosclerosis. When a higher concentration of cadmium was given, osteoporotic appearance supervened. On cadmium analysis with an x-ray microanalyzer, a definitely higher concentration gradient of cadmium was revealed at the portion where calcium metabolism is active, such as the growing and developing sites in bone. (auth)

10489 RETENTION OF AMERICIUM AND CALCIUM BY THE SKELETON OF GROWING AND MATURE FEMALE RATS. Hollins, J. G.; Durakovic, A.; Storr, M. C. (National Research Council of Canada, Ottawa). Calcified Tissue Res.; 12: No. 3, 239-246(1973). (NRCC-13241).

The retention of ^{47}Ca and ^{241}Am by 14 parts of the skeleton of growing and mature female rats 7 days after injection was measured. The various parts of the skeleton possessed widely differing abilities to concentrate both these elements. The bones of the younger rats had a significantly greater ability to concentrate ^{241}Am but not ^{47}Ca. The implications of these results for the radiation dosimetry of internal contamination by ^{241}Am are discussed. (auth)

10490 ACCUMULATION OF RADIOACTIVE NUCLIDES IN FISH. Ichikawa, T. (National Inst. of Radiological Sciences, Chiba, Japan). pp 234-297 of Radioactivity and Fishes. Contamination, Injurios, and Utilization. Egami, N. (ed.). Tokyo; Koseisha Kosei Kaku (1973). (In Japanese).

The accumulation of fallout nuclides emitted from nuclear weapons tests and environmental radioactive nuclides from atomic power facilities in oceanic and freshwater fish was examined referring to 245 reports. The intake and metabolism of nuclides in fish are described using the model of exponential function. The condensation factor (CF) was obtained from the results of division of the level of radioactive nuclides in fish by the level of radioactive nuclides in water, when the nuclides taken into fish were equally balanced by its environmental nuclides. CF values of freshwater and oceanic fish are shown in tables. Such items as experimental equipment, rearing equipment, and measuring methods for the experiments on radioactive nuclear metabolism were suggested. As for naturally occurring radioactive nuclides, ^{40}K, U, Ra, ^{210}Pb, and ^{210}Po in fish were mentioned. As for nuclides produced by nuclear fission, the effects of ^{90}Sr, ^{137}Cs, and ^{131}I on the intake and metabolism in fish were explained. Especially, Sr quantitative examination can be done effectively by comparing with Ca. When strontium unit or Sr-Ca observed ratio (OR) was arranged, movements of ^{90}Sr in food chain can be known quantitatively, and the effects of exposure dose on the human body can be presumed. The Sr-Ca OR values were examined in various kinds of living things and the results are shown. Moreover, the distributions of ^{137}Cs, ^{131}I, and ^{32}P in fish are also shown. Such induced radioactive nuclides as ^{60}Co, ^{65}Zn, ^{55}Fe, ^{54}Mn, ^{51}Cr, ^{110m}Ag, and Pu, that are produced from materials of the atomic reactor, showed the half-life from several months to a few years. These facts provide interesting suggestions for the problems of the environmental radioactivity and the internal exposure of the human body. The level of nuclides in the water and oceanic fish, and the intake of nuclides in fish under experimental conditions were examined in the nuclear bombing experimental field and atomic submarine base. (JA)

10491 COMPARISON OF TUMOR UPTAKE AND KINETICS OF DIFFERENT RADIOPHARMACEUTICALS UNDER EXPERIMENTAL CONDITIONS. Emrich, D.; von zur Muehlen, A.; Willgeroth, P.; Lemmich, A. (Univ., Goettingen, Ger.). Acta Radiol., Ther., Phys., Biol.; 11: No. 6, 566-576(Dec 1972).

Using the transplantable Yoshida sarcoma in the rat, radiation activity concentrations were determined in tumor, blood, and muscle at various times for ^{67}Ga-citrate, ^{99m}Tc-pertechnetate, ^{75}Se-selenite, $^{203}HgCl_2$, ^{197}Hg-H-albumin, ^{197}Hg-BMHP, ^{203}Hg-chlormerodrin, and ^{131}I-H-albumin. Gallium-67 exhibited the highest tumor uptake and the most favorable tumor/blood ratio. For some radiopharmaceuticals the extent of tumor uptake correlated with their biologic half life in the blood. There is some evidence that the model might be comparable with the human. (auth)

10492 WHOLE-BODY RETENTION AND INTESTINAL ABSORPTION OF ^{115m}Cd IN YOUNG AND ADULT MICE. Matsusaka, N.; Tanaka, M.; Nishimura, Y.; Yuyama, A.; Kobayashi, H. (Iwate Univ., Morioka, Japan). Igaku To Seibutsugaku; 85: No. 6, 275-279(Dec 1972). (In Japanese).

A1 μCi/g body weight dose of $^{115m}CdCl_2$ in 150 μCi/ml of distilled water was given orally to young (7, 14, 21 days old) and adult mice, respectively. The retention rate of $^{115m}CdCl_2$ in each group of mice was counted by whole-body counter. The higher retention was observed in young mice. In the youngest group of mice (7 days old) in particular, the retention rate was comparatively high for the first 7 days after administration and decreased abruptly, which decreasing pattern was different from that in other groups. By counting the radioactivity in the extracted digestive tract of the youngest group of mice, it is estimated that about 66% of administered ^{115m}Cd was retained in the digestive tract and only 9% was retained in the other part of the body 24 hrs after administration. The retention rate of ^{115m}Cd absorbed through the digestive tract 21 days after administration in the 7-, 14-, 21-day old mice and

adult mice were 9, 8, 4, and 0.9% respectively of the total administered doses. In consecutive administration, absorption rate was also higher in the digestive tract of young mice. In each group, the excretion rate of ^{115m}Cd was slight. (JA)

10493 GROWTH AND REMODELING OF THE HIP JOINT AND PROXIMAL FEMUR IN ADOLESCENT DOGS. An Investigation with Special Reference to Hip Dysplasia and Estradiol Induced Changes. Gustafsson, P. O.; Kasstroem, H.; Olsson, S. E.; Suzuki, K. (Hospital for Special Surgery, New York). Acta Radiol., Suppl.; No. 319, 3-5(1972).

From second international conference of veterinary radiologists; Stockholm, Sweden (1970).

Strontium-85 scintimetry was done on dogs with normal and dysplastic hip joints. It was found that the uptake was higher in dysplastic hip joints. It was lower in the metaphysis of the proximal femur in dogs with hip dysplasia than in normal dogs. Prenatal administration of estradiol retarded growth of cartilage in the proximal femur more than 6 months after birth. (SW)

10494 CALIFORNIUM: STUDY OF ITS METABOLISM IN RELATION TO THAT OF OTHER TRANSURANIC ELEMENTS. Morin, M.; Nenot, J. C.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). Radioprotection; 8: No. 1, 33-36(1973). (In French).

The metabolism of ^{252}Cf is compared with other trivalent transplutonium elements in spite of its faster uptake from the site of entry into the organism and its faster bone clearance. (FR)

Plants

10495 (FOA-4-4557-A-3) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. XIV. Uptake of ^{137}Cs by Wheat and Timothy from Six Different Soils as Influenced by Rate of K-Fertilization and by Type and Rate of N-Fertilization in Pot Experiments. Haak, E.; Eriksson, A. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Oct 1973. 39p. Dep. NTIS (U.S. Sales Only) $4.00.

The influence of K and N fertilization on the uptake of ^{137}Cs by wheat and timothy grass was studied in pot experiments with 6 soils of different texture and potassium contents. Three rates of K application were combined with three types of N fertilizer (calcium nitrate, ammonium nitrate, and urea) each of which was applied at three rates. The effect of prolonged cropping was also studied. It was found that the soil quality and the uptake of K mainly determined the uptake of ^{137}Cs at low K and N rates. The concentration of ^{137}Cs in the crops was negatively related to the contents of clay and K. K fertilization reduced the uptake of ^{137}Cs considerably. This effect decreased, however, with increased contents of clay and K. The effect of N fertilization was dependent on the type of N fertilizer, N rate, and K level. While increased application of calcium nitrate slightly decreased the ^{137}Cs content in the plant, increased application of ammonium nitrate or urea highly increased it. Both effects decreased with increased K rate and with increased contents of clay and K in the soil. Prolonged cropping resulted in higher ^{137}Cs content in the plant on soils with low contents of clay and K, while the reverse was the case on soils with high contents of clay and K. (SW)

10496 (FOA-4-4559-A-3) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. XV. Uptake of ^{137}Cs by Wheat as Influenced by Type and Rate of N-Fertilization Under Field Conditions. Haak, E.; Eriksson, A. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Oct 1973. 28p. Dep. NTIS (U.S. Sales Only) $3.50.

The influence of N-fertilization on the uptake of ^{137}Cs by wheat was studied for four years in a micro plot experiment with two clay and one sandy soil, all on a sandy subsoil. Calcium nitrate, ammonium nitrate, and urea were applied to the seedbed yearly at three rates. The soil quality of the plough layer mainly determined the uptake of ^{137}Cs by the wheat crop. The ^{137}Cs concentration in the plant was several times higher on sandy soil than on clay soils. It varied considerably from year to year on all the three soils, most certainly depending on the differences in the root activities in the soil profile caused by different amounts and distribution of precipitation during the growth periods. Because of this variation, continued cropping is needed for a reliable determination of the changes in the plant availability of ^{137}Cs under field conditions. The N-type and the N-rate influenced the ^{137}Cs uptake and was of practical significance on the sandy soil. On this soil the ^{137}Cs concentration in the plant increased with the N-rate and was usually higher for ammonium nitrate and urea than for calcium nitrate. The ^{137}Cs concentration was usually much lower in the grain than in the straw but the difference varied between soils and between years. (SW)

10497 EFFECT OF MINERAL TYPE AND SOIL MOISTURE CONTENT ON PLANT UPTAKE OF ^{137}Cs. Shalhevet, J. (National and Univ. Inst. of Agriculture, Rehovoth, Israel). Radiat. Bot.; 13: No. 3, 165-171(Jun 1973).

The effect of moisture content on ^{137}Cs uptake by plant roots may be controlled by two main soil factors, ion diffusion and ion concentration. In an experiment employing a split root technique, where a constant moisture content was maintained, uptake was diffusion-controlled and therefore reduced as moisture content decreased. When moisture was allowed to fluctuate in a drying and wetting cycle, uptake was concentration controlled: the drier the soil, the higher the uptake. Fixing ^{137}Cs interlayer spaces of vermiculite by K treatment or fixing ^{137}Cs on edge fixation sites in illite, resulted in a drastic reduction in uptake. In these systems, whatever uptake there was came from sources of soluble ^{137}Cs that were present in small concentrations. (auth)

Microorganisms

10498 ENZYMATIC RADIOIODINATION OF THE ENVELOPE PROTEINS OF AVIAN MYELOBLASTOSIS VIRUS. Fritz, R. B. (Emory Univ., Atlanta). J. Virol.; 13: No. 1, 42-45(Jan 1974).

Purified avian myeloblastosis virus was iodinated by the lactoperoxidase method. Disruption of the labeled virions and chromatography of the viral proteins showed that radioiodine was associated only with the glycoproteins of the viral envelope. Reaction of the radiolabeled virus with antiviral antibody followed by mild detergent treatment and subsequent recovery of immune complexes showed this technique to be useful for the isolation of viral envelope antigens. (auth)

10499 PROTEINS SPECIFIED BY HERPES SIMPLEX VIRUS. X. Staining and Radiolabeling Properties of B Capsid and Virion Proteins in Polyacrylamide Gels. Gibson, W.; Roizman, B. (Univ. of Chicago). J. Virol.; 13: No. 1, 155-165(Jan 1974).

Analyses of the structural proteins of herpes simplex virions and of capsids containing viral DNA (B capsids), after electrophoresis in polyacrylamide gels, revealed considerable variability in their properties with respect to: retention of Coomassie brilliant blue (CBB) and fast green stains during destaining, relative optical absorbance of the CBB-protein complex at different wavelengths, relative efficiency with which ^{14}C-amino acids are incorporated during early and late periods of the infection cycle, and capacity to be phosphorylated in vivo. In addition, it was found that protein 22a of B capsids, which does not have an electrophoretically identical counterpart in virions, shares a relatively unique set of staining and radiolabeling properties with virion protein 22, which has a slightly more rapid electrophoretic mobility in sodium dodecyl sulfate-polyacrylamide gels. (auth)

New Tracer Techniques

Refer also to abstracts 9762, 9972, 9994, 10409, 10456, 10478, and 10482.

10500 (BNL-18379) CARRIER-FREE ^{11}C-LABELED CATECHOLAMINES IN NUCLEAR MEDICINE AND BIOCHEMICAL RESEARCH. Fowler, J. S.; Wolf, A. P.; Christman, D. R.; MacGregor, R. R.; Ansari, A.; Atkins, H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 23p. (CONF-740203-2). Dep. NTIS $3.25.

The catecholamines, dopamine, norepinephrine, and epinephrine, are synthesized and secreted by tissues such as brain, sympathetic nerve endings, and chromaffin cells. Dopamine and norepinephrine are primarily neurotransmitters while epinephrine functions mainly as a hormone. The biosynthesis of the catecholamines from tyrosine is reviewed. Abnormalities in the quantities and metabolism of these compounds are associated with many pathological conditions such as hypertension, Parkinsonism, and chromaffin tissue tumors. Rapid synthetic methods (for the preparation of) ^{11}C-labeled catecholamines have been developed. The potential use of these labeled catecholamines as scanning agents for the adrenal glands and heart myocardium was evaluated in dogs. (CH)

10501 (CEA-CONF-2184) ACTUAL SITUATION AND DEVELOPMENT OF THE USE OF RADIOELEMENTS IN MEDICAL DIAGNOSIS. Sauvagnac, R.; Henry, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 9p. (In French). (CONF-720567-2). Dep. NTIS (U.S. Sales Only) $3.00.

From 7th national congress on the monitoring of ionizing radiations conference; Marseilles, France (16 May 1972).

The use of radionuclides for medical diagnostic tests in the United States, Japan, and France is briefly reviewed with respect to the radionuclides, the quantity used, and the number of radiopharmaceutics used. The development of these uses is discussed

with emphasis on the increasing use of radionuclides with short half-life, γ emitters without β, and cyclotron produced radionuclides. Their use has sharply diminished the dose absorbed by the patient, but the necessity of manipulating and administering significant amounts of activity has exposed hospital personnel to risks during the use of radioisotopes. Methods for the preparation of ^{99m}Tc, ^{113m}In, ^{131}Cs, and ^{197}Hs from radioisotope generators are described that reduce the radiation dose received by personnel. (tr-auth)

10502 (IAEA-R-751-F) QUANTITATIVE EVALUATION OF VALVULAR AND REGURGITATION INSUFFICIENCY BY MEANS OF GASEOUS RADIOACTIVE TRACERS. Final Report for the Period 1 March 1969–29 February 1972. Ortiz Berrocal, J.; Arnaiz Bueno, F.; Pedraza Muriel, V.; Chamorro Romero, J. L.; Castillo Olivares, J. L.; Martin Judez, V.; Poli Mathias, M. (International Atomic Energy Agency, Vienna (Austria)). Apr 1972. 18p. INIS.

A technique for evaluation of mitral regurgitation based on continuous perfusion using an aqueous solution of ^{85}Kr or ^{133}Xe into the left ventricle and the sampling of blood from the left auricle and a peripheral artery for radioactivity measurements was developed. Measurements of mitral regurgitation by the technique in 5 dogs with experimental mitral insufficiency showed a reasonable correlation with the degree of insufficiency induced. Measurements in 17 patients with varying degrees of mitral insufficiency showed reasonable correlation with the degree of insufficiency present, as estimated by cineangiocardiography by measuring the height of the v wave of the left auricular pressure or by direct observation during surgical intervention. It was concluded that the technique described provides a useful complementary method to cineangiocardiography for the evaluation of mitral insufficiency, with the advantage of not requiring the injection of iodine-containing contrast media and the disadvantage of not giving morphological information about the condition of the mitral valve. (INIS)

10503 (IAEA-R-808-F) DEVELOPMENT OF CINESCINTILLOGRAPHIC QUANTITATIVE TECHNIQUES. Final Report for the Period 15 October 1969–14 October 1972. Touya, J. J. (International Atomic Energy Agency, Vienna (Austria)). 1972. vp. (In Spanish). INIS.

Quantitative cinescintigraphic techniques are being developed for kinetic studies for a gamma camera with a video-recorder, and to investigate the applicability of these techniques in studies of renal, hepatic and pulmonary pathology. The development of the whole system was completed, and the quantitative studies were carried out in 560 serial renal, 60 serial hepatic, and 40 pulmonary scintigrams. (INIS)

10504 (TID-3319-S5) NUCLEAR MEDICINE. Bibliography from Nuclear Science Abstracts, Volumes 26 and 27. (USAEC Technical Information Center, Oak Ridge, Tenn.). Dec. 1973. 406p. Dep. NTIS $10.60.

References are presented to 1589 publications related to nuclear medicine that were announced in Nuclear Science Abstracts volumes 26(1972) and 27 (Jan to June 1973). (CH)

10505 CLINICAL RADIOLOGY. Nuclear Medicine. Hisada, K. (Kanazawa Univ., Japan). Nippon Iji Shimpo; No. 2551, 27-34(Mar 1973). (In Japanese).

The present status of clinical radiology is described with regard to education, instruments, and radioactive medicine with reference to 67 papers. Residency curriculum of nuclear medicine has begun to be prepared, and the chair for nuclear medicine was initially recognized at Kanazawa University. Almost all of the radioimmunoassay methods performed in Japan were double antibody method. However, sephadex-coupled antibody method, which was more convenient, has appeared. Further simplification of radioimmunoassay by sephadex-coupled antibody method, and development of automatic data processing system were expected to be promoted. ^{99m}Tc-polyphosphoric acid was known to be very useful for scintigraphies. Nuclides for scintigraphy include ^{18}F, ^{11}C, and ^{13}N of short half-life nuclides; ^{131}I-stingnasterol, ^{131}I-19-cholesterol, ^{131}I-DDD for the adrenal glands; ^{111}In and ^{203}Pb-EDTA for the cerebral ventricle; ^{67}Ga-citrate and ^{169}Yb-citrate of carcinophilic RI, and so on. As improvements of measuring instruments, the invention to attach an electric marker to the scinticamera, and the adoption of pin-hole collimator and conversing collimator were marked. Scintigraphy, which was conventionally a supplementary diagnosing method, became possible to provide more detailed diagnosis by combined RI method such as combination of liver scintigraphy and α-fetoprotein radioimmunoassay for liver examination. Diagnosis of hereditary metabolic disorders by RI in vitro, and RI angiography of the bone marrow were possible now. Diagnosing ability was promoted by improved image shadow based on the use of a computer. (JA)

10506 STUDIES ON THE CIRCULATION OF THE FEMORAL HEAD USING CATHETER SEMICONDUCTOR RADIATION DETECTOR. Hayashi, M. (Chiba Univ., Japan). Nippon Seikei Geka Gakkai Zasshi; 47: No. 7, 581-617(Jul 1973). (In Japanese).

The radioisotope used in those studies was ^{32}P-deisopropyl-fluorophosphate (DF^{32}P) which is a blood-seeking pure beta emitter. In order to detect the radioactivity in the femoral head in vivo, a catheter semiconductor radiation detector with a sufficiently small size and sensitivity to beta radiation was inserted into the femoral head. The counting rates recorded at the femoral heads of human normal controls increased rapidly for the first few minutes, and a plateau was reached in five minutes or so. The counting rates recorded at each portion of normal control were almost constant. The head-to-trochanter ratios were approximately 1.0 in four cases. In the six hips of the five patients with idiopathic avascular necrosis, the head-to trochanter ratios of counts per minutes were correlated to pathological change in the portions, i.e., the ratios of 0.15 to 0 were obtained in the portions with roentgenographical density and pathological necrosis or sclerosis, while 0.56 to 1.20 were obtained in the radiolucent and vascular-fibrous portions. In the six hips of the six patients with fracture of the femoral neck (non-union), the head-to-trochanter ratios of 0.26 to 0 were correlated with pathological changes such as bone necrosis, sclerosis, and marrow fibrosis. In the sixteen hips of the fifteen patients with osteoarthritis, the head-to-trochanter ratios 1.02 to 0.08 were correlated to degenerative process of the disease, suggesting the decrease of arterial blood flow along with the aggravation of the process. It was concluded that this method is useful in estimating the arterial blood flow in the femoral head with a decrease or partial or total increase and hence for diagnosis and prognosis. (auth)

10507 VIDEO-TAPE RECORDING IN RADIOISOTOPIC STUDY OF THE BRAIN. Cerebrovascular Disorders. Handa, J.; Matsuda, M.; Ohtsubo, K.; Handa, H.; Kousaka, T. (Kyoto Univ.). No To Shinkei; 25: No. 9, 1129-1139(Sep 1973). (In Japanese).

A video-tape recording system was introduced in radioisotope cerebral angiography with ^{99m}Tc-pertechnetate and in ^{133}Xe cerebral scintigraphy. Time-activity data were fed into a 1-inch wide video-tape and displayed later on the oscilloscope for detailed study and eventual photographic recording. The method proved to be of extreme value for improving the detection rate, especially of the small pathologic foci, decreasing the error of instrument setting which is often inevitable with direct photographic recording method, and cutting down the patient's expense for examination. By use of pen-writing recorder, videotape recording provided time-activity curves and the regional cerebral blood flow, cerebral vascular bed, and cerebral transit time could be calculated for multiple regions of interest. In cerebrovascular disorders, those data of regional circulation apparently were of great value for clinical as well as research purposes, particularly in combination with the visual images of radioisotope angiogram and ^{133}Xe cerebral scintigram. (auth)

10508 STUDIES ON THE DIGITAL PROCESSING FOR IMAGE DATA IN NUCLEAR MEDICINE. Kojima, K. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 93: 41-72(Jun 1973). (In Japanese).

In on-line processing by CDS-4096, data processing could be executed under visual observation and the results could be obtained at renal time. Especially, the interface was originally made for transferring the data from the scanner (MUHC) into the CDS-4096, and has made possible to connect these two machines effectively. As the on-line processing functions in CDS-4096, visual modes and computing modes were included. The images could be improved something by threshold, isocount display, smoothing by threshold, isocount display, smoothing, and subtraction operations in many modes. Furthermore, a light pen accessory was applied for sampling of pattern characteristics and quantitative analysis of images, and the satisfactory results have been obtained. Off-line processing was tried using the general purpose computer FACOM-230/35 and NEAC 2230 by means of paper tapes. The programs improving images that could not be executed by CDS-4096 were made. Good results have been obtained among those programs for correction of nonuniformity in camera sensitivity, multiselected threshold levels display and contour display. The more accurate dynamic study could be done by finding the time histogram of radioisotope accumulation in the regions of interest that were assigned exactly in the image. It was necessary to store exactly the original data without decreasing image quality. It was concluded that about 16 kilo words were suitable for memory capacities of the computer in this system, and also that the numbers of display points forming an image on the cathode ray tube should be increased to the degree that each display point was not discreted. (auth)

10509 RADIOLOGICAL STUDY OF THE EFFECT OF LOW CALCIUM DIET ON THE MINERAL METABOLISM OF BONE TISSUE. With Reference to Mineralization in Callus. Nakamura, K. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 91: 35-50(Jan 1972). (In Japanese).

Deficiency of available food material due either to poor diet or to malabsorption may adversely affect the skeleton. To study the affection, DDN mice were fed low calcium diet to induce low calcium state corresponding to malabsorption of calcium from the intestine. The femur was fractured manually. Then, calcium deposition in the callus was observed by microradiography and tracer technics with ^{47}Ca. Increase of the body weight in mice fed low calcium diet was much slower than in the control. The affection of the low calcium diet on bone tissue appeared as a decrease of precipitation of calcium salt. This tendency was also observed in callus. Tracer study with ^{47}Ca was performed in mice fed the low calcium diet for 24 days. Incorporation activity of calcium was generally high in each organ except the kidney. Callus in the site of the fracture in mice fed a low calcium diet was formed to the same degree as the control, although the amount of precipitated calcium in it was significantly poorer. In summary, insufficient mineralization in relation to osteogenesis occurred when the supply of the requisite electrolytes was insufficient or inappropriate. On the other hand, the uptake rate of calcium in the callus was elevated even in the calcium deficient state. (auth)

10510 CORRECTION OF IMAGE DISTORTION IN THE LIVER SCINTIGRAM DUE TO THE RESPIRATORY MOVEMENT USING AN ON LINE COMPUTER SYSTEM. Matsumoto, T.; Fukuda, N.; Yabumoto, E.; Fukuhisa, K. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 8, 653-666(Nov 1972). (In Japanese).

Image distortion in the liver scintigram due to the respiratory movement often confuses physicians in its interpretation. An attempt to correct this distortion was described using an on-line digital computer system. The procedure was as follows: (1) the respiratory movement was sampled by a collimated NaI (Tl) detector positioned beneath the bed seeing the edge of the liver, (2) an original scintigram was divided into five sub-scintigrams according to the phase of the respiratory curve, having equal total counts in each, (3) the center point of gravity of each sub-scintigram was calculated, (4) the sub-scintigrams were shifted and superimposed so that each center point of gravity fitted to the center of the image. Phantom experiments using a respiration simulator showed sufficient recovery of the image quality in terms of focal lesion detectability and the smoothness of the edge of organ. Moreover, the actual magnitude of the movement was precisely estimated in a two-dimensional plane using the center point of gravity of each sub-scintigram. Several considerations in application for clinical liver scans were also discussed. Of these, the usefulness of the correction in computer image processing, such as smoothing, was specially stressed. (auth)

10511 QUANTITATIVE ANALYSIS OF A NEGLIGIBLE QUANTITY OF IMMUNOGLOBULIN E BY RADIOACTIVE IMMUNITY DIFFUSION USING TRACER-LABELED IMMUNOGLOBULIN E. Shibata, K. (Hoechst Japan Ltd., Tokyo); Terano, Y.; Ichihashi, H.; Kitani, K.; Inai, M. Arerugi; 22: No. 5, 365-369(May 1973). (In Japanese).

Iodine-125-labeled immunoglobulin E (^{125}I-IgE) was infused to the sampler holes on the plate of adequate diluted antibody. The subject's serum or standard IgE was infused after several minutes, 10 days and 30 days, and immunity diffusion was done at room temperature for 48 hrs. On the basis of the theory of Mancini, serum IgE was directly quantified on the radioautogram. One standard curve could be used without the effects of the time from ^{125}I-IgE infusion to standard IgE (serum of subject) infusion. This method is good for screening test. When the concentration of IgE was beyond the measurable limits of this method, excess and too small in quantity of IgE were evidently identified. It was practical as the subject's serum could be simply measured on a plate. This method did not produce liquid radioactive waste. Radioactivity for one reaction hole used in this study might be about several hundred pCi, so that it was safe. The degree of dilution in anti-IgE serum was adequately decided, and precision and sensitivity were controlled. As a disadvantage, it took significant time to perform radioautography, since an extremely small amount of radioactivity was used. (JA)

10512 RADIOIMMUNOASSAY PRINCIPLES. Proceedings of a Conference Held in Paris, France, May 25-19, 1972. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). 557p. (In French and English). (CONF-720598-).

From seminar on radioimmunoassay; Paris, France (15 May 1972).

The conference included 48 papers on radioimmunoassay principles. The application of radioimmunoassays to fertility, reproduction, pituitary, placental, and electrolytic homeostasis hormones, and gonadotropins was excluded. Separate abstracts were prepared for 30 papers. Three papers were previously abstracted for NSA. The abstracts appeared as 27:28103, 28104, and 28105. (FR)

For abstracts of individual papers see: 10513-10542.

10513 PREPARATION AND ASSESSMENT OF ^{131}I- OR ^{125}I-LABELED HORMONES FOR USE IN RADIOIMMUNOASSAY PROCEDURE. Hunter, W. M. (Medical Research Council, Edinburgh). pp 17-36 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The preparation and quality control of ^{131}I- and ^{125}I-labeled hormones are discussed. The following topics are considered: the different ways in which ^{131}I- and ^{125}I-labeled hormones are detected; the utilization of the chloramine T reaction; alterations linked with the substitution of iodine in the hormone molecule; and the steps taken to avoid damaging the hormone with radiations or the chemical products present. The different stages involved in the purification of the hormone are described, particular attention being given to the separation of the nonlabeled antigen from the iodinated antigen as well as the separation of the noniodinated and di-iodinated antigenes. The amount of damage likely to occur during the incubation and the immunological verification of such damage are also discussed. (FR)

10514 APPLICATION OF IMMUNOADSORBENTS TO RADIOIMMUNOASSAY. Catt, K. J. (National Institutes of Health, Bethesda, MD). pp 37-47 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From Seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The immunosorbents usually used to purify antibodies facilitate the separation of antigen and antigen bound to the antibody. Radioimmunological determinations in solid phase necessitate the coupling of the antibodies to a support represented by fine particles of cellulose or dextran or discs or tubes of polystyrene. The bonding of the antibodies to the plastic support represents an optimum in the precise dilution limits of 0.05 M and pH 9.6 in bicarbonate or 0.01 M and pH 7.8 in Tris. With the majority of the hormones the initial B/T is between 0.25 and 0.4, but with this method good results can be obtained even with B/T between 0.1 and 0.2. The radioimmunological determination in the solid phase was used to measure, in addition to the hormones, fibrinogen, gammaglobulins, thyroglobulin, and immunoglobulins. With this method labeled proteins released during biosynthesis in vitro can be isolated and measured. The immunosorbents are also used in immunoradiometric determination; they permit the detection and measurement of antibodies in plasma, for example in the plasma of allergic subjects. They permit the purification of the most specific antibodies used in radioimmunological determinations. In a double antibody system the precipitating gammaglobulins can be fixed on an immunosorbent and be used in an automation system with continuous output. (tr-auth)

10515 METHODS USED TO SEPARATE FREE HORMONES FROM ANTIBODY BOUND HORMONES IN PEPTIDE HORMONE RADIOIMMUNOASSAYS. Desbuquois, B. (Institut National de la Sante et de la Recherche Medicale (INSERM), Paris). pp 49-58 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The methods used to separate free hormones of antibody-hormone complexes from peptide hormones in radioimmunoassays are described. The principles, applications, and characteristics of each method are discussed. Emphasis is given to the latest techniques concerning the distribution of free or antibody-bound hormones in certain hormones forming two immiscible liquid phases. A recently developed technique utilizing a polyethylene glycol precipitation method, which is particularly interesting for radioimmunoassays with substances of low molecular weight, is presented. This technique is also useful for radioimmunoassays of insulin, the growth-stimulating hormone, the parathyroid hormone, vasopressin, and cyclic AMP. (FR)

10516 RADIOIMMUNOLOGICAL DETERMINATION OF ENZYMES. Application to Pancreatic Trypsin, Chymotrypsin, Amylase, and Lipase. Felber, J. P. (Clinique Medicale Univ., Lausanne). pp 59-69 of Radioimmunoassay Principles. Bou-

logne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The application of the radioimmunological method to the measurement of enzymes brings up an interesting opening in the field of enzymology. The major advantage over catalytic methods resides in the very high sensitivity of the assay. The specificity of the assay is of immunological order and is not directly related to the biological activity of the enzyme. The development of the assay makes it necessary to use pure enzyme preparations, as impurities may interfere with the assay. Moreover, the enzymes used for the development of the assay need to be of the same animal species as the enzyme to be measured, unless complete cross reactions can be demonstrated. Assays were developed for beef, pork, and rat trypsin, beef and rat chymotrypsin, rat amylase, and rat lipase. The first results show that the enzyme concentration of the pancreatic juice is directly related to the type of food received by the animals. (auth)

10517 RADIOIMMUNOASSAY FOR DETERMINATION OF NUCLEOTIDES. Determination of Cyclic AMP. Rosselin, G.; Broer, Y.; Grapin, A. M. (Hospital Saint-Antoine, Paris). pp 71-84 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The preparation of the products used in the cyclic AMP radioimmunoassay: succinyl-2'-cyclic AMP and tyrosyl methylester succinyl cyclic AMP (TME-S AMPc) is discussed. Results concerning the preparation and the control of these products are presented. Different methods for purification of the iodinated TME-S AMPc are tested for their immunoreactivity with antibodies to albumin succinyl AMPc. The conditions of a specific assay are developed and more particularly the specific and nonspecific substances capable of giving variations of the iodinated TME-S AMPc antibodies binding not due to the presence of cyclic AMP in the tested sample. (auth)

10518 RADIOIMMUNOASSAY TECHNIQUE FOR THE SYSTEMATIC CONTROL OF AUSTRALIA ANTIGEN IN DONOR BLOOD. Amouch, P.; Drouet, J. (Centre National de Transfusion Sanguine, Paris). pp 91-98 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

A radioimmunoassay method for systematically controlling the amounts of Au antigen and anti-Australia antigen in donor blood is presented. The method is sensitive, very specific, and automated. Only very small quantities of reagent are used. In this way donor blood can be rapidly controlled by few personnel in a manner which avoids the consuming of large quantities of anti-Australia serum. (FR)

10519 NON-SPECIFIC FACTORS INTERFERING IN RADIOIMMUNOASSAYS. Girard, J.; Baumann, J. B.; Stahl, M.; Nars, P. W. (Univ. Children's Hospital, Basel). pp 99-111 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From Seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Radioimmunoassay methods are very sensitive to changes in the antigen concentration, this concentration often being itself very sensitive to nonspecific factors. In order to avoid errors in the estimation or interpretation of the results, the following points must be taken into consideration: the adsorption of antigens and antibodies by the tubes and pipettes; the complete separation between hormones, which are free or bound to the antibodies; chromatographic degradation; a crossed reaction leading to a hormone nonspecific; and nonspecific factors not connected with the hormones. (FR)

10520 STANDARDS FOR RADIOIMMUNOASSAY OF PEPTIDE HORMONES. Cotes, P. M. (National Inst. for Medical Research, London). pp 113-124 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

For comparison of estimates by radioimmunoassay made on different occasions and in different laboratories it is necessary to set aside certain hormone preparations to be used as standards. This need arises because assay systems are not entirely specific and batches of hormone preparations are seldom identical. The ideal standard is a sample of the exact molecular species which it is intended to measure, stable and dispensed in a homogeneous form. For scarce materials it may be convenient to freeze dry the active peptide with added carrier substances. The standard should then be considered as the whole mixture. Ideal materials are seldom available. The problems of selecting suitable alternative materials are discussed. A number of substances intended for use as standards are distributed by the Division of Biological Standards. Materials which may be suitable for use in radioimmunoassay of human hormones are listed. (auth)

10521 RADIORECEPTOR ASSAYS OF POLYPEPTIDE HORMONES: STUDIES FROM ONE LABORATORY. Roth, J. (National Institutes of Health, Bethesda, MD). pp 125-130 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From Seminar on Radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The specific binding of ACTH to a protein of the adrenal cells was used in radioimmunoassay of the plasmatic ACTH. This method has advantages over other radioimmunoassay techniques utilizing competitive binding and, in addition, permits a specificity more similar to the properties of the hormone to be obtained. The cellular receptors are prepared by homogenization followed by fractionating using differential centrifugation. The cultivated lymphocytes appear also to be a source of receptors for radioimmunoassays for insulin and the growth-stimulating hormone. The incubation takes place at temperatures of the order of 10 to 15°C; the equilibrium state is reached after a few minutes or a few hours. The separation can be effected with silicates by centrifugation or filtration. (FR)

10522 CHARACTERISTICS OF PLASMA PROTEINS AND RECEPTORS USED FOR THE DETERMINATION OF STEROIDS. Determination of Plasma Progesterone by Means of Progesterone Binding Plasma Protein (PBP). Pichon, M. F.; Milgrom, E. (Hopital, Bicetre, France). pp 131-147 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Some properties of plasma proteins and tissular receptors used in the assay of steroids are discussed. A new and simple assay for progesterone is reported. It is based on the use of PBP (Progesterone Binding Plasma Protein) of pregnant guinea pig. The narrow specificity of this protein makes it possible to measure directly progesterone in petroleum ether plasma extracts without prior chromatography. Pregnant guinea pig plasma diluted 1,600 fold was used. Separation of free from bound hormone was achieved by dextran-coated charcoal treatment. Recovery of ^{3}H-progesterone after extraction was 81.1 ± 0.7% (S.E.M.). The sensitivity was about 100 pg of progesterone. Accuracy and specificity were tested by addition of progesterone and competing steroids to plasma. The precision estimated by the coefficient of variation was 9.6% in the same assay and 24.7% in two different assays. Plasma progesterone concentrations in men, post-menopausal women, women with normal cycles and during pregnancy are reported. (auth)

10523 STATISTICAL METHODS IN RADIOIMMUNOLOGY. Valleron, A. J. (Institut National de la Sante et de la Recherche Medicale, Villejuif, France). pp 149-172 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The following parameters of statistical methods used in radioimmunoassay are discussed: reproducibility; precision of determinations; detection; sensitivity; accuracy; and quality control. The different methods of expression of the standard curve are described, and their application to estimation of an unknown quantity of hormone is discussed. The choice of experimental plan is also discussed. (HLW)

10524 PREPARATION AND CHARACTERISTICS OF SPECIFIC ANTIBODIES OF THE HUMAN FOLLICLE STIMULATING HORMONE H.FSH. Dolais, J.; Freychet, P.; Rosselin, G. (Institut National de la Sante et de la Recherche Medicale (INSERM), Paris). pp 183-201 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

In order to obtain and study the characteristics of anti-FSH immune serums, the following steps are necessary: immunization with pituitary preparations containing sufficient FSH; studies of the specificity with ^{131}I-labeled FSH after saturation of the immune serums with HCG; studies of the binding of immune serums to ^{131}I-labeled TSH and ^{131}I-labeled LH which enables the existence or nonexistence of specific TSH or LH antibodies to be established.

More complete investigations can be envisaged for the α and β sub-units. (FR)

10525 RADIOIMMUNOASSAYS OF HUMAN CHORIONIC GONADOTROPIN (HCG) AND HUMAN PITUITARY LUTEINIZING HORMONE (LH). Franchimont, P. (Univ., Liege). pp 203-218 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

LH and HCG can be determined in the serum and urine by radioimmunologic methods. The hormones are labeled with ^{131}I or ^{125}I and are detected by adsorption on kaolin, by reactions with an excess of antibody for LH and HCG, and by electrophoresis in starch for HCG. Procedures are given for separating free LH from antibody-bound LH, incubating standards and unknowns in the double antibody system, preparation of reference materials, radioimmunoassay of LH and HCG in serum, and radioimmunoassay of LH in urine. (HLW)

10526 RADIOIMMUNOASSAY OF PLASMA ESTRADIOL PROGESTERONE AND TESTOSTERONE. Dufau, M. L.; Catt, K. J. (National Institutes of Health, Bethesda, MD). pp 219-235 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Anti-steroid immune serums obtained by immunization with steroids conjugated to proteins give antibodies enabling sensitive measurements to be made of estradiol, progesterone, and testosterone after plasma extraction. In the systems used, the equilibrium constants are of the order of 10^{10} l/mode, the best results being obtained at low temperatures with solutions containing small quantities of protein; the separation is performed with charcoal, taking the precaution of ensuring that the control tubes do not contain antibodies. The extraction yield is obtained using a tritiated steroid as a tracer. For each steroid, the coupling conditions necessary to obtain antibodies are discussed and the technical details concerning the carrying out of the assay are given. Results of testosterone assays are given. (FR)

10527 RADIOIMMUNOASSAY OF OVINE AND BOVINE PLASMA LH. Pelletier, J. (Institut National de Recherches Agronomiques, Nouzilly, France). pp 237-255 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

This original method proposed for assays of the plasmatic luteinizing hormone (LH) of cattle is compared to existing techniques. The specific activity of the ^{125}I and the ^{131}I-labeled hormone varies between 150 and 250μCi/mg. The antiserums obtained from immunized guinea-pigs were selected by their titers and their avidities in relation to the LH radioactivity and were used in the following dilutions: $1/150,000$ (anti-LH ovine) and $1/750,000$ (anti-LH bovine). The assay sensitivities are 50pg for the ovine LH and 30pg for the bovine LH. The specificity and accuracy were satisfactory. (FR)

10528 RADIOIMMUNOASSAY OF RAT GONADOTROPINS. Kerdelhue, B.; Pitoulis, S.; Berault, A. (CNRS, Gif-sur-Yvette, France). pp 257-270 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Radioimmunoassays of the gonadotropins of rats were performed, i.e. of the luteinizing hormone (LH) and the follicule-stimulating hormone (FSH), utilizing anti-LH and FSH ovine serums and labeled rat gonadotropins. The ovine antigonadotropin anti-serums obtained from guinea pigs demonstrated a good specificity in relation to the FSH and TSH of the rat. These anti-FSH ovine antiserums react weakly with the LH of the rat and more strongly with the TSH of the rat. Comparisons between biological assays and radioimmunoassays of the LH demonstrated a good correlation between the two systems. However, the radioimmunological technique enables lower values to be obtained for the FSH than with the biological method. (FR)

10529 RADIOLIGAND-RECEPTOR ASSAYS FOR HCG AND LH. Catt, K. J.; Dufau, M. L. (National Institutes of Health, Bethesda, MD). pp 271-283 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Radioiodinated luteinizing hormone fixes in a specific manner in vivo rat testis Leydig cells and in vitro testis homogenates. Comparable binding sites of high affinity for HCG were also demonstrated for the pseudopregnant rat ovary. In the technique proposed the 40 to 60μCi/mg labeled HCG retains its biological activity; the testis fractions are isolated by homogenization and centrifugation at 1500xg; the ovary fractions are obtained by homogenization and represent the fraction sedimenting between 120 and 2000g. The incubation period at room temperature is 16 hours; the separation is performed by centrifugation. This type of assay enables the direction of 5mIU HCG and takes into account the LH, but not the other hypophyseal hormones. (FR)

10530 ASSAY OF HUMAN GROWTH HORMONE IN PLASMA. Hunter, W. M. (Medical Research Council, Edinburgh). pp 285-404 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Plasma levels of human growth hormone in man are between 1 and 100μu/ml in terms of the 1st International Reference Preparation of approximately 1 to 50ng/ml of the pure hormone. The immune sera are obtained from rabbits, decomplemented, and stored after freezing. The separation technique currently used involves the use of a double antibody with donkey immune serum precipitating the rabbit serum. The nonspecific interferences and the way in which they are avoided are stated. The protocol of the assay of the somatotropic hormone, the establishment of the standardization curve, and the calculation of the HGH plasma level are discussed in detail. The rapid changes occurring in the plasmatic HGH level can now be related to well defined physiological situations. There are no large differences between the behavior observed with adults and that observed with children. (FR)

10531 RADIOIMMUNOASSAY OF PROSTAGLANDIN $F_{2\alpha}$. Patrono, C. (Catholic Univ. of the Sacred Heart, Rome). pp 291-300 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

F2α(PGF2α) anti-prostaglandin antibodies were obtained by immunizing guinea pigs with PGF2α previously coupled to rabbit albumin by 1-ethyl-3-(3-dimethyl-aminopropyl) carbodiimide. One of the immune sera obtained can bind 35% of the PGF2α-^{3}He (25pg/ml) at the final dilution of $1/10,000$. After 3 hours incubation at 4°C, the separation between the free tritiated PGF2α and that bound to the antibody was effected using a carbon suspension in a phosphate buffer. The system is sensitive to the addition of 20pg of standard PGF2α per ml. The immune serum presents only a very weak crossed reaction with other prostaglandins. (FR)

10532 RADIOIMMUNOASSAY OF HUMAN THYROID STIMULATING HORMONE. Lemarchand-Beraud, T. (Hopital Cantonal Universitaire, Lausanne, Switzerland). pp 303-322 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Studies of the relation between the hypothalamus, hypophysis, and thyroid were accomplished with high precision using radioimmunoassays of the hypophyseal hormone, the thyroid stimulating hormone. The introduction of an international human reference standard TSH, the obtaining of more specific antibodies, and recent modifications enabled the sensitivity and the precision of the assay to be improved. It is concluded that this assay enables thyroid insufficiencies (even small insufficiencies) to be established, the plasmatic TSH being always above normal. The method appears to be particularly well suited to the differential diagnosis between primary and secondary hypothyroidism as well as for observations and treatment. (FR)

10533 RADIOIMMUNOASSAY SPECIFICITY OF HUMAN AND ANIMAL THYROID-STIMULATING HORMONES AND HUMAN CHORIONIC THYROID-STIMULATING HORMONES. Freychet, P. (Institut National de la Sante et de la Recherche Medicale, Paris); Rosselin, G.; Dolais, J.; Hennen, G.; Pelletier, J. pp 323-350 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The radioimmunoassay specificity of bovine, ovine, and human thyroid-stimulating hormones was studied, particular attention being given to the specificity of the anti-TSH/TSH antibody reaction. This study was effected from two points of view: that of the immunoassay specificity of the TSH species (interspecies specificity); that of the immunoassay specificity of human TSH in relation to other human hypophyseal and chorionic glycoproteins (intraspecies specificity). The principal characteristics envisaged for the specificity of radioimmunoassay systems developed for human, bovine, and ovine TSH are presented together with those corre-

sponding to the human chorionic thyroid-stimulating hormone (HCT). (FR)

10534 RADIOIMMUNOASSAY OF βMSH. Donnadieu, M.; Sevaux, D. (Hoptial Trousseau, Paris). pp 367-374 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Plasmatic assays of βMSH melanocyte stimulating hormones were performed, the antiserums being obtained by immunizing guinea pigs with purified pig ACTH or Freund's adjuvant. A synthesized human βMSH reference is used. The tracer is labeled with ^{131}I and the principal radioactivity peak used. The incubation is carried out during an eight day period and the final separation performed using a charcoal-dextran mixture. The specificity of the antibodies was studied with other molecules possessing structures having various degrees of similarity with βMSH. The results obtained by this method of assay lead to values of between 20 and 150pg/ml for normal subjects and between 140 and 1500pg/ml for subjects with Addison's disease; high values are obtained in the case of Cushing's disease and para-neoplastic syndromes. The values obtained in various pigmentations for individuals free from endocrine troubles are normal. (FR)

10535 SPECIFICITY OF ACTH, α, AND βMSH RADIOIMMUNOASSAY. Felber, J. P. pp 375-384 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Radioimmunoassay specificity problems connected with ACTH are complex. It appears that ACTH circulates in human plasma in two different forms: in the form of a substance having the same molecular weight as ACTH and in the form of a substance having a higher molecular weight. The existence of fragments of ACTH circulating in the plasma was also established these fragments possessing a biological activity depending upon the ACTH chain that they represent. In addition, crossed reactions exist between certain anti-ACTH antibodies and α and βMSH. The antibodies produced by injecting ACTH or MSH in laboratory animals are also heterogeneous. The above considerations emphasize the difficulties encountered in attempting to resolve the specificity problems and the falsification of the assays due to the confusion between active ACTH and inactive fragments. Nevertheless this assay has clinical applications, and it is because of this assay that information is available on the different forms of circulating ACTH. (FR)

10536 RADIOIMMUNOASSAY OF OVINE PLASMA PROLACTIN. Suitability for the Assay of the Human Prolactin. Kann, G. (Institut National de la Recherche Agronomique, Jouy-en-Josas, France). pp 409-420 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

A sensitive radioimmunoassay technique for dosage of ovine prolactin (O.Pr.) is described. It is proposed that this system be used for the measurement of human prolactin (H.Pr.). Ovine prolactin was labelled using chloramin T, either with ^{131}I or ^{125}I. The specific activity was about 200 and 100 $\mu C/\mu g$ and the yield of iodination reaction about 90%. The labelled preparation of O.Pr. was further purified by filtration on Sephadex G 100, after separation from excess radioactive iodine by chromatography on Sephadex G 50. Antiserum against O.Pr. was obtained from guinea pigs. A double antibody system is used to separate free O.Pr.* from O.Pr.* antibody complex. The sensitivity of this assay is in the range of 0.010 ng of O.Pr. (N.I.H. PS7). Good specificity of the dosage was found, using other adenohypophysis ovine hormones. The specificity against H.G.H. and H.C.S. (or H.P.L.) was also investigated. No cross reaction was obtained. (auth)

10537 RADIOIMMUNOASSAY OF HUMAN CHORIONIC SOMATOTROPIN (HCS OR HPL). Haour, F.; Cohen, M.; Bertrand, J. (Institut National de la Sante et de la Recherche Medicale, Lyon). pp 421-432 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Chorionic somatotropin hormone (CSH) can be assayed using radioimmunoassay techniques; the level of plasma HCS measured in women approaching the end of pregnancy varied for different workers depending on the technique used. In the method described, a purified extract of placenta was used. Antisera obtained from rabbits or guinea pigs possess higher titers and do not undergo important crossed reactions with HCG and TSH. The labeling of the hormone with ^{131}I or ^{125}I gave a specific activity of 150mCi/mg in the first case and an activity of 20mCi/mg in the second case. Another method described utilizes a Solavo extract and the double antibody technique. A new technique is described for the determination of free and antibody-bound HCS, the dioxane technique being used. (FR)

10538 RADIOIMMUNOASSAY DETERMINATION OF ANGIOTENSIN II AND PLASMA RENIN PARAMETERS. Catt, K. J. (National Institutes of Health, Bethesda, MD). pp 449-458 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

The radioimmunoassays applied to angiotensin I are difficult to apply to the measurement of circulating angiotensin II as the renin may continue to act for a short time after the blood samples are taken, the antibodies may undergo a crossed reaction with the renin substrate and another plasma component, and the angiotensin I may bind strongly with a plasma protein. The angiotensin II plasma levels measured were 1.9 ± 1.2ng% (venous blood) and 2.5 ± 1.4ng% (arterial blood). The plasma renin activity was determined by incubating the plasma in the presence of BAL, EDTA, and 8 hydroxquinoline. Angiotensin I assays were performed for 25 and 50μl aliquots. The renin was assayed in an excess of renin substrate. The renin substrate was assayed in the plasma using inhibitors to suppress the formation of angiotensin I. (FR)

10539 PLASMA ALDOSTERONE RADIOIMMUNOASSAY USING TRITIATED ALDOSTERONE. Bayard, F.; Beitins, I. Z.; Kowarski, A.; Migeon, C. J. (Johns Hopkins, Univ., Baltimore). pp 489-509 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

A radioimmunoassay for the measurement of plasma aldosterone is described. Aldosterone-3-carboxymethoxime-18,21-diacetate was coupled with albumin to form an antigen which was administered to rabbits. A small quantity 1,2-3-aldosterone was added to the plasma samples to facilitate the calculation of losses before extraction using dichloromethane and chromatography. After 20 minutes incubation of the antibody-steroid mixture, the bound and the free fractions were separated using Florisil. The specificity of the method was examined by comparing the results obtained by this radioimmunoassay method with those obtained using a double isotope derivative method: the results were not significantly different. The variation in the position of the body has a rapid effect on the aldosterone plasma concentration; the sodium regime also has a very sharp effect on the plasma aldosterone level. (FR)

10540 ARGININE VASOPRESSIN (AVP): RADIOIMMUNOASSAY IN BIOLOGICAL FLUIDS IN MAN. Gorden, P. (National Institutes of Health, Bethesda, MD); Robertson, G. L.; Beardwell, C.; Klein, L. A. pp 511-520 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Antibodies having strong affinities for AVP can be prepared by injecting AVP or AVP coupled to a larger protein into rabbits. Purified AVP can be labeled with ^{125}I and purified to a very high specific activity suitable for immunoassay. With an appropriate buffer and adjustment in the concentration of the antiserums and ^{125}I-AVP, a standard curve can be generated. The ^{125}I-AVP is displaced by the antibody with increasing concentrations of unlabeled AVP. Plasma cannot normally be assayed directly in this system but must first be extracted by filtration on G-25 Sephadex to free the AVP from interfering material. Plasma AVP can be assayed directly with certain antiserums after freeing the AVP from the major plasma proteins by acetone-ether extraction. Plasma AVP can be bound to Florisil and the remaining plasma components removed: the AVP may then be eluted from the Florisil and assayed directly. (FR)

10541 LABELLING OF PROTEIN HORMONES WITH RADIOIODINE FOR RADIOIMMUNOASSAY. Drout, J. (CNTS, Paris); Hegesippe, M.; Meriadec, B. pp 523-532 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

Among the various techniques used to label proteins, the chloramine T method presents some advantages which are reviewed from the practical point of view. Mayberry's theory is rapidly shown to explain the iodination mechanism of the tyrosyl residues. Problems encountered with the specific activity of the carrier

free radioiodine solution are discussed concerning ^{131}I and ^{125}I. Practical data are given. Reagents for iodination with chloramine T techniques are given. A general description of the methods of purification is given. At last, a demonstration of purity control of the final product and the different results obtained by purification of insulin on alumina column will be made by technicians. Problems concerning storage, adsorption, stability of labelled proteins will be discussed with the students. (auth)

10542 RADIOIMMUNOLOGICAL DETERMINATION OF URINARY INSULIN. Isaac, R.; Nivez, M. P.; Paillard, F.; Ardaillou, R. (Hopital Tenon, Paris). pp 537-549 of Radioimmunoassay Principles. Boulogne, France; Institut National de la Sante et de la Recherche Medicale (1972). (In French).

From seminar on radioimmunoassay; Paris, France (15 May 1972). See CONF-720598-.

An outline is presented of the procedure for determining urinary insulin using a veronal buffer of pH8.6 and ^{131}I-labeled insulin. The range of standard solutions of insulin for calibration is presented and preparation of guinea pig antibodies and urine samples is described. Procedures are given for incubation, separation, and counting. Results are calculated from counting data using the total radioactivity of insulin in each tube and the proportion of the total which is bound to the antibodies during incubation. Experimental tests for validation of the method are described. Studies were made of urinary clearance of insulin in diverse pathological conditions. The experimental controls as well as the results of clearance studies seemed to prove the validity of the method. An inconvenience of the method is the necessity of establishing a particular calibration range for each patient. (HLW)

10543 ROLE OF INDIUM-113m AND YTTERBIUM-169 IN NUCLEAR MEDICINE. Wagner, H. N. Jr.; Hosain, F. (Johns Hopkins Medical Institutions, Baltimore). pp 3-10 of Annual Conference of the Society of Nuclear Medicine. Mazumdar, S. K. (ed.). New Delhi; Organizing Committee for the Second Annual Conference of the Society of Nuclear Medicine (1970).

From annual conference of the Society of Nuclear Medicine; New Delhi, India (21 Oct 1970).

Indium-113m is a convenient shortlived radionuclide for the use in nuclear medicine as it can be obtained from a long-lived generator system. Millicurie amounts of this carrier-free radionuclide can be safely administered for rapid scanning with decreased radiation dose to the patients. Simple chemical manipulations of indium-113m eluate yield different radiopharmaceuticals (ionic, coloidal, aggregated, and chelated forms) which are used in various organ scanning (heart, placenta, liver, lung, brain, and kidney). Its versatility as an all-purpose radionuclide for scanning makes it very attractive. Ytterbium-169 chelate is a new radiopharmaceutical that has a multipurpose use. It is an excellent stand-by agent for brain scanning, ideally suited for cisternography, and conveniently used for the measurement of glomerular filtration rate. Long physical half-life and high chemical stability permit strict quality control; and the short biological half-life reduces the radiation dose. (auth)

10544 ION-EXCHANGE CHROMATOGRAPHY OF GLUCOSAMINE AND GALACTOSAMINE IN MICROGRAM AMOUNTS WITH DETERMINATION AND SPECIFIC-RADIOACTIVITY ASSAY. Lohmander, S. (Karolinska Inst., Stockholm). Biochim. Biophys. Acta; 264: No. 3, 411-417(1972).

Purified hydrolysates of tissue (from animals to which ^{14}C-labeled hexosamine precursors were administered) are fractionated on a column of Aminex A-5 ion-exchange resin (K^+ form) at 60°, with a phosphate buffer solution of pH 7.0 as eluent. Half the volume of each hexosamine-containing fraction is analyzed by a scaled-down Elson–Morgan procedure, and half is used for liquid scintillation counting. From 0.01 to 1 μmole of each hexosamine can be separated and determined. There is no interference from amino-acids, hexoses, or glucuronic acid. Studies on the products of [^{14}C] glucose metabolism in guinea-pig rib cartilage show that the presence of radioactive peptides does not affect the determination of specific activities of hexosamines. (Anal. Abstr.)

10545 ISOTOPE-DERIVATIVE METHOD OF ANALYSIS FOR PROSTAGLANDINS E_1 AND E_2 IN SERUM BY USING SULFUR-35-LABELED 2-AMINOTHIAZOLE AS REAGENT. Bojesen, E.; Buchhave, K. (Univ. of Copenhagen). Biochim. Biophys. Acta; 280: No. 4, 614-625(1972).

Tritiated prostaglandins are added to the sample, as internal standards, and the compounds are extracted into acetone, then into dichloromethane, and finally into aqueous methanol. The N-2-[^{35}S] thiazolyl derivatives of the amides corresponding to the prostaglandins are then formed, and the derivatives of the E prostaglandins are separated and purified by a series of reactions involving their conversion into the acetylated amide derivatives of B prostaglandins, the reaction products being separated at each stage by thin-layer chromatography. The acetylated derivatives of the B prostaglandins are finally determined by liquid scintillation counting of ^{3}H and ^{35}S. Details are given of all stages of the procedure. The sensitivity is ≈ 0.2 pM for either the E prostaglandins. (Anal. Abstr.)

10546 METHOD OF MEASURING THYROID ^{131}I UPTAKE BY A DIGITIZED SCINTIGRAM OF THYROID GLAND. Kakehi, H.; Saegusa, K. (Chiba Univ., Japan). pp 149-155 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

A method using a dual-detector scanner and on-line computer for measuring the late uptake of ^{131}I by the thyroid is described. The method can be applied during routine scans of the thyroid and was found to give results in general agreement with those obtained by the ORINS standard method. (auth)

10547 MEASUREMENT OF THE KINETIC CONSTANTS DESCRIBING THE THYROIDAL CONCENTRATION AND ORGANIC BINDING OF IODIDE AND PERTECHNETATE. Shimmins, J. G.; Robertson, J. W. K.; Alexander, W. D.; Lazarus, J. (Western Regional Hospital Board, Glasgow). pp 75-89 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

Studies are described of the kinetics of iodide-trapping and iodine-binding by the thyroid in normal and hyperthyroid subjects based on computer analysis of the data resulting from serial ^{99m}Tc and ^{131}I uptake measurements made with a single-detector scanner during the 45 min following the administration of the mixed tracers. Studies were carried out on 10 normal and 4 hyperthyroid subjects to whom carbimazole had been given to block iodine-binding by the thyroid. Analysis of these data yielded values for the unidirectional iodide clearance into the thyroid and the fractional iodine-binding rate. Further studies were carried out on 15 normal and 7 hyperthyroid subjects to whom no carbimazole had been given. Analysis of these data yielded values for the unidirectional iodide clearance into the thyroid, the fractional iodide loss rate from the thyroid, and the fractional iodine-binding rate. The results indicate a very significantly higher unidirectional iodide clearance and a significantly higher fractional iodine-binding rate in hyperthyroid as compared with normal subjects. No significant differences in fractional iodide loss rates was observed between the group studied. The significance of the findings is discussed. (auth)

10548 APPLICATIONS OF SHORT-LIVED CYCLOTRON-PRODUCED RADIOISOTOPES. Brownell, G. L.; Hoop, B. Jr.; Burnham, C. A. (Massachusetts General Hospital, Boston). pp 17-22 of Annual Conference of the Society of Nuclear Medicine. Mazumdar, S. K. (Ed.). New Delhi; Organizing Committee for the Second Annual Conference of the Society of Nuclear Medicine (1970).

From annual conference of the Society of Nuclear Medicine; New Delhi, India (21 Oct 1970).

The development of small, compact cyclotrons has made cyclotron-produced isotopes more accessible to medical centers. In particular, ^{15}O, ^{13}N, and ^{11}C offer great promise for clinical studies. Methods were developed for producing and purifying these radioisotopes. The Massachusetts General Hospital (MGH) Positron Camera is designed to record activity from these isotopes at high data rates. Clinical studies have commenced in pulmonary physiology and brain and heart blood flow at Physics Research Laboratory of Massachusetts General Hospital, Boston, Mass., U.S.A. Studies on other organs are planned. (auth)

10549 MEASUREMENT OF THE THYROID UPTAKE OF ^{99m}Tc, ^{131}I, AND ^{132}I AT EARLY TIMES AFTER ISOTOPE ADMINISTRATION. Shimmins, J. G.; Alexander, W. D. (Western Regional Hospital Board, Glasgow). pp 63-73 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

A method using a single-detector scanner for measuring the early uptake of ^{99m}Tc, ^{131}I, or ^{132}I by the thyroid is described. The method was tested by comparing the uptake values obtained in 16 subjects on five occasions during the 45 min following administration of the tracer with those obtained on two interpolated occasions by means of a fixed collimated scintillation detector fitted with a standard thyroid collimator. In only one case was there a significant difference between the two sets of measurements. The ^{131}I activity detected with the fixed detector was

equal to that in a 15.8 cm diameter circle on the scan. The method described also permits measurement of extrathyroidal activity. From the results of such measurements mean values for the extrathyroidal ^{99m}Tc and ^{131}I activity detected by the fixed detector at different times after administration of the tracer were calculated. These values were used to formulate equations from which the early uptake of these radionuclides can be calculated from measurements with the fixed detector, if shortage of time or other considerations preclude the use of the more accurate scanning method. (auth)

10550 CELL CYCLE OF MATRIX CELLS IN THE MOUSE EMBRYO DURING HISTOGENESIS OF TELENCEPHALON. Hoshino, K. (Nagoya Univ., Japan); Matsuzawa, T.; Murakami, U. Nagoya Daigaku Kankyo Igaku Kenkyusho Nempo; 20: 103-106(1973).

Pregnant female mice were injected intraperitoneally with 5μ Ci/g body weight of ^{3}H-thymidine (spec. act. 12μCi/mM) at 1:30 p.m. on day 10, 13, or 17 of gestation and were put to death at 1 or 2 hr intervals per group. Embryos were removed quickly from mothers and fixed in Bouin's solution. The prepared slides were observed microscopically. The duration of the cell cycle of the matrix cells of the telencephalon was determined by direct graphic measurement, plotting the percentage of labeled mitosis against the time after ^{3}H-thymidine injection according to the method of Quastler and Sherman. The total cell cycle times in day 10, 13, and 17 groups were 7.0, 15.5, and 26.0 hr, respectively. It was characteristic in the alteration of cell cycle of matrix cells in the telencephalon during mouse embryonic life that not only G_1 but also S phase lengthened linearly with embryonic age, and both G_2 and M phases remained constant. According to these facts, the matrix cells seemed to change cytogenetically with increase of age so as to produce different neurons that would progressively make up different layers in the neocortex. (JA)

10551 SPECIFICITY OF SOLID PHASE RADIOIMMUNOASSAY OF AUSTRALIA ANTIGEN AND ANTI-AUSTRALIA ANTIGEN. Seto, Y.; Inagaki, M.; Shimamura, Y. (Keio Univ., Tokyo). Kaku Igaku; 9: No. 5, 469-474(Oct 1972). (In Japanese).

The specificity of solid-phase radioimmunoassay method for Australian antigen (Au-ag) and anti-Australian antigen (Au-ab) was confirmed. Au-ab was coated quantitatively on the surface of polyethylene tubes. The Au-ab coated reacted quantitatively with ^{125}I-labeled Au-ag. The ^{125}I-labeled Au-ag showed positive reaction by using a tube coated with Au-ab, but negative by using tube coated with normal sera or any other kinds of antibody. The combination of ^{125}I-labeled Au-ab complex that was formed on the surface of a coated tube was blocked with unlabeled Au-ab. When normal human serum, several kinds of animal sera, several viruses, enzymes, and hormones were estimated in solid phase radioimmunoassay (SP-RIA), no increase of radioactivity was observed. When Au-ag or Au-ab was quantitatively detected by SP-RIA, the cutoff value to be accepted as a positive value should be beyond seven standard deviations from the negative control serum cpm. The arbitrary unit of Au-ag and Au-ab could be obtained from the estimated value in SP-RIA. (auth)

10552 RADIOISOTOPES. Computer Application for Medicine. Iinuma, T. (National Inst. of Radiological Sciences, Chiba, Japan). Sogo Rinsho; 22: No. 1, 51-56(Jan 1973). (In Japanese).

The recent development of computer applications in the field of nuclear medicine and application for radioisotope scintigraphy in particular are discussed. Computer applicable information in nuclear medicine is divided into four types: sample measuring, as represented by radioactivity counting; progressively changing information such as level counting in the renogram according to time sequence; scan image information represented by distributed value counting in scintigraphy; and such changing information as those of radionuclide kinetics scanned in scintigraphy. The paper describes data processing in scintiscanning devices with gamma camera attached, converting image information from digital to analog with reference to equipment and data acquisition methods that differ according to the type of equipment. Image quality transformation and feature extraction, modulation transfer function, refocusing, and the method of convolution integral are also discussed. The National Institute of Radiological Sciences, Japan, is developing an on-line data processing system for scintiscanning data by use of a large gamma camera. For clinical use of the computer, inter-diciplinary cooperation should be expected especially in the computer installed hospital for the development of computer attached information handling system as an integral part of the whole hospital operation. (JA)

10553 STUDY USING RADIOACTIVE ^{133}Xe OF THE REGIONAL DISTRIBUTION OF A DRUG ADMINISTERED BY ARTERIAL INFUSION. Ogawa, S. (Japanese Foundation for Cancer Research, Tokyo). Gan No Rinsho; 19: No. 4, 335-342(Apr 1973). (In Japanese).

The blood flow in the tumor and its surrounding tissues was analyzed by using ^{133}Xe in order to obtain basic information relating to the effectiveness of arterial infusion in cancer chemotherapy. Fourteen cases were studied: six cases of breast cancer, four cases of maxillary cancer, three cases of secondary cancer of the liver, and one case of pelvic cancer. A dose of 0.3 to 0.5 mCi of ^{133}Xe, dissolved in 5 ml distilled water, was administered rapidly into the catheter placed in the regional artery, and the activity was recorded by using scintillation camera and scintillation counter. Clearance curves obtained were analyzed. Clinical effects could be well correlated and explained by ^{133}Xe distribution patterns. The blood flow pattern in deep tissues or in deep focus could also be evaluated. Xenon-133 scintiphotography was found useful to determine whether the tips of the inserted cannula are in the right position or not. (auth)

10554 ANALYSIS OF ^{131}I-THYROXINE BOUND PROTEIN BY THE ADVERSE PARTIGEN METHOD. Nakagawa, S. (Kumamoto Univ., Japan); Yumoto, Y.; Shibata, K. Igaku No Ayumi; 84: No. 5, 261-262(Feb 1973). (In Japanese).

20μCi of ^{131}I-thyroxine (T_4) was added to the serum samples (0.1 to 0.2 ml) obtained from 1 normal adult, 2 patients with thyroxine-binding globulin (TBG) defect, and 1 patient with decreasing TBG. The samples were dissolved in agarose solution and were dried, to which anti-sera were added. The prepared samples were examined by autoradiography and with protein-dye method. The significant radioactivity was observed in prealbumin, β-lipoprotein, and hemopexin in the serum sample of normal adult. This finding is suggested that limopexin is one of the thyroxine binding protein (TBP), for it is binding with ^{131}I-T_4. The radioactivity was slight in albumin and α_1-lipoprotein. No significant defference was observed between serum samples of normal adult and of TBG defective patient. (JA)

10555 BONE SCINTIGRAPHY OF THE AGED PATIENT. 1. ^{99m}Tc-POLYPHOSPHATE BONE SCINTIGRAPHY. Yamamoto, M.; Chiba, K.; Tanno, M. (Tokyo Metropolitan Geriatric Medical Center). Kaku Igaku; 9: No. 6, 561-568(Dec 1972). (In Japanese).

Application and evaluation of a new bone-seeking radiopharmaceutical, ^{99m}Tc-polyphosphate are reported. Analysis of the image by digital color display data analyzer (Phosdac) was performed. The subjects of the study were cases at Tokyo Metropolitan Geriatric Hospital ranging from 63 to 85 years old with several kinds of bone diseases. Polyphosphate kits (Diagnostic Isotopes, Inc.) were used to prepare ^{99m}Tc, and a Rho/gamma HP gamma-camera was used for scintigraphy. The images obtained were analyzed by Phosdac to obtain clear image of the bone system. In the final preparation, presence of approximately 30% of free ^{99m}Tc was noticed by paper chromatography. ^{99m}Tc-polyphosphate was cleared from the blood with a half time of about 60 min. Urinary excretion proved to be 40 to 60% within 24 hrs. The bone system was visualized rather clearly with high accumulation of the label in the diseased region in spite of the fact that geriatric cases had marked general osteoporotic tendencies. In some cases, ribs were clearly visualized, and different information from that of x-ray was obtained by scanning images. Data processing by Phosdac increased diagnostic accuracy by enhancing the difference of the density of the image as well as eliminating the background caused by free $^{99m}TcO_4^-$. In conclusion, ^{99m}Tc-polyphosphate was proved to be useful for bone scanning in geriatric cases. A digital color display data analyzer was successfully applied for the processing of the original data. (auth)

10556 TUMOR SCINTISCANNING WITH ^{99m}Tc-LABELLED BLEOMYCIN. Torizuka, K.; Mori, T.; Hamamoto, K. (Kyoto Univ.). Gan No Rinsho; 19: No. 4, 269-273(Apr 1973). (In Japanese).

Metabolism and tumor affinity of ^{99m}Tc-bleomycin (^{99m}Tc-BLM) were investigated, in particular comparing with those of ^{67}Ga-citrate. The ^{99m}Tc-BLM concentrated in the kidneys at first and rapidly excreted in the urine after intravenous injection of ^{99m}Tc-BLM to normal rats or mice, while 1% of the administered dose was retained in the tumor lesion soon after injection to tumor-bearing mice (0.58% retention was still observed after 24 hrs). In 89 clinical cases with malignant tumors, 82% (73 cases) were positive by scintigraphy with ^{99m}Tc-BLM while 65% was positive with ^{67}Ga-citrate. Nonspecific retention was higher using ^{67}Ga-citrate in the cases with inflammation, in which 53% showed positive delineation. The retention of ^{99m}Tc-BLM was observed even in the small squamous cell carcinoma which was difficult to be detected with ^{67}Ga-citrate. The ^{99m}Tc-BLM also showed strong affinity to fibromas, malignant melanomas, and retinoblastomas. The use of ^{99m}Tc-BLM is more effective for tumor scintiscanning for the following reasons: examination is possible within a short period of time; less exposure doses; high reliability in diagnosis; specific affinity to tumor; and ready availability. (JA)

10557 MICRODETERMINATION OF ADRENOCORTICAL STEROIDS BY DOUBLE ISOTOPE METHOD. 2. Fractional

Determination of Corticosteroids: Free and Protein-Bound Cortisol, Corticosterone in Plasma. Kunugi, A.; Matsumoto, U.; Nagase, Y. (Tokyo Coll. of Pharmacy). Endocrinol. Jap.; 20: No. 1, 23-31(Feb 1973).

Further examinations were made on the double isotope derivative dilution method by the use of thiosemicarbazide-^{35}S as the labeled reagent and ^{3}H-labeled corticosteroid for correcting the loss during extraction and separation procedure, and fractional determination of free and protein-bound cortisol and corticosterone. The Δ^4-3-ketosteroids with similar chemical structure present in plasma, namely, cortisol, corticosterone, aldosterone, deoxycorticosterone, and cortisone, can be separated by repeating thin-layer chromatography at a low temperature of 10°C more than four times. Cortisol and corticosterone can be determined correctly and with good precision, relative standard deviation being 1 to 2%. The other three corticosteroids can be determined correctly and with good precision, relative standard deviation being 3 to 6%. It was found that the protein-bound cortisol and corticosterone in plasma are dissociated during solvent extraction, and the total amount is determined in free form. It was also found that the protein-bound and free cortisol and corticosterone can be separated by gel filtration, and the combination of gel filtration and the present method of determination has made it possible to carry out fractional determination of bound and free forms of cortisol and corticosterone. The quantity per 100 ml of plasma was found to be 1.83 and 0.18 μg of free cortisol and corticosterone, and 17.45 and 1.75 μg of protein-bound cortisol and corticosterone, respectively. (auth)

10558 IN VIVO APPLICATIONS OF RADIOISOTOPES. Torizuka, K.; Hamamoto, K. (Kyoto Univ.). Genshiryoku Kogyo; 19: No. 7, 31-35(Jul 1973). (In Japanese).

Use of ^{99m}Tc, which has a short life and no β rays, has made the mass administration of radioisotopes possible and outlined images satisfactorily. A rapid ^{99m}Tc labeling kit has been exploited in Japan and is conveniently used for ^{99m}Tc-albumin, ^{99m}Tc-sulfur colloid, ^{99m}Tc-tin colloid, ^{99m}Tc-polyphosphate, and ^{99m}Tc-DTPA. Gallium-67, ^{111}In, ^{169}Yb, and bleomycin labeled with ^{57}Co or ^{99m}Tc, which are radioisotopes with tumor affinity, have been exploited. For outlining organs, there are detector mobile instruments (scintiscanner and isosensitive scanner) and detector fixed instruments (Anger camera, autofluoscilloscope, multiple image intensifying tube-type camera, and gas emitting tube camera). By attaching multiple pulse amplitude analyzer and high-speed magnetic tape data store play back apparatus to the Anger camera, computer processing of data is performed. The image by radioisotope scan includes noise due to statistical fluctuations of counting and blurring due to poor resolution of the detector. An attempt is being made to increase the resolution by collecting the output from scinticamera and scanner as the digital volume and using computer, and the author's processed cases were introduced. Problems in the dynamic study of the circulatory system by scinticamera are uniformity of sensitivity of the visual field of camera and loss of the proportionality between counting and the amount of radioisotope due to voluminous radioisotope administration. Practical methods of tomographic scintigraphy have been developed, but since their resolution is poor, exploitation of an excellent radioisotope imaging instrument is desired. (JA)

10559 ON-LINE DATA PROCESSING OF RADIOISOTOPE SCINTIGRAPHY USING A SMALL COMPUTER. Saegusa, K.; Kakehi, H.; Arimizu, N. (Chiba Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 7, 587-594(Oct 1972). (In Japanese).

In conventional radioisotope scintigraphy, the image obtained is interpreted by human visual systems as qualitative patterns. However, the process sometimes results in losing much diagnostic information. This report deals with the utilization of a small computer for delineating the digital images and making its further computer analysis. The original data either derived from an Anger camera or from a whole-body scanner are directly stored into the 4K core memories of the computer in digital form. The field of view contains about 1K image cells over the areas of 30 × 30 cm^2 to 50 × 180 cm^2. For kinetic studies of digital images, 8 × 8 image cells are adopted over the field of view and 32 frames of images are successively stored at the intervals of choice. As instructed by a program set up in advance for data processing, the computer performs mathematical procedures on the stored data, displaying the processed images so that human eyes can easily extract the diagnostic information from them. Five methods of image processing are described: smoothing; subtraction; contrast enhancement; differential imaging; and dynamic histograms on a regional area of interest. The practical applications of these methods are demonstrated. (auth)

10560 PULMOGRAM FOR READING PULMONARY SCINTIGRAM. Tsuchida, T.; Oka, T. (Osaka City Shirokita Hospital). Rinsho Hoshasen; 18: No. 9, 657-662(Sep 1973). (In Japanese).

By describing (pulmogram) the distribution of radiation in the lungs simultaneously with pulmonary scanning, pulmonary functions were determined from the pattern of this curve and the area ratio (blood flow ratio) as an indicator for diagnosis. The subjects were three cases of pulmonary tuberculosis, three cases of pulmonary cancer, and one case complicated by spontaneous pneumothorax during the course of pneumonia, a total of seven who showed a total defect of a unilateral lung on pulmonary scintigram. The area of the pulmogram was measured with a planimeter. With Pr as the value of the right lung area, Pl as the value of the left lung area, and PT as the value of the total lung area (Pr + Pl), Pr/PT, Pl/PT, and Pl/Pr could be used as diagnostic indicators for semiquantitative determination of pulmonary functions. Pulmonary scintigram and pulmogram were compared in diagrammatic presentation. Scintigram showed a total unilateral lung defect, but pulmogram indicated a small accumulation of ^{131}I-macroaggregated albumin(MAA) and the presence of a small pulmonary flow volume. Demonstrated in diagram as diagnostic indicators were the absolute value and the ratio (blood flow ratio) between right and left of the area of pulmogram of each case and the distributional ratio of blood flow in the right lower lung, left upper lung, and left lower lung supposing that the area of the upper right lung was 1. Factors influencing pulmogram were the position of the body, the direction of scanning, and the recording conditions. (JA)

10561 CLINICAL APPLICATIONS IN NUCLEAR MEDICINE IN JAPAN (1972). I. Testing Apparatuses. Kakehi, H.; Saegusa, K. (Chiba Univ., Japan). Radioisotopes (Tokyo); 22: No. 4, 215-219(Apr 1973). (In Japanese).

Of 839 Japanese institutions that are thought to be applying radioisotopes to clinical practice, a questionnaire was sent to 461, excluding 378 that are thought to perform in vitro tests alone. It was sent in the middle of July 1972 and was recovered in the beginning of December from 328 institutions (71.1%). The number of effective responses was 299, from 50 university hospitals and 249 general hospitals. They were requested to write the presence or absence, name of maker, and name of apparatus possessed concerning nine types of instruments and apparatuses in six items: apparatus for measuring samples (well counter, fluid scintillation counter, others); apparatus for measuring the isotope uptake rate of thyroid; renographic apparatus; whole-body counter; apparatus for dynamic function tests and others; and scintigraphic apparatus (scintiscanner, scinticamera, etc.). In comparison with the survey performed in 1969, in vitro tests have rapidly increased and the use of scinticamera has remarkably increased in in vivo tests. In combination with the data processing apparatus, the progress of data analysis is anticipated. The present numbers (1972) of apparatuses and instruments for tests in nuclear medicine according to 70% responses were: well counter 356, fluid scintillation counter 47, other sample measuring apparatuses 63, apparatus for measuring the uptake rate of thyroid 144, renographic apparatus 171, whole-body counter 10, apparatus for dynamic function tests 53, scintiscanner 288, and scinticamera 123. (JA)

10562 ADVANTAGES OF THE GAMMA-CAMERA IN THYROID EXPLORATION. Galle, P.; Hazard, J.; Perlemuter, L.; Bernheim, R.; Pitton, R.; Gelinet, M. (Hopital Henri Mondor, Creteil, France). Ann. Endocrinol. (Paris); 34: No. 1, 40-47(Jan 1973). (In French).

Images of the thyroid gland obtained using gamma cameras present numerous advantages over those obtained by scanners, in particular for the study of cold nodules, the thyroglossal duct or ectopic thyroids, and generally in every case where iodine uptake is very low. (auth)

10563 LYMPHATIC ABSORPTION OF 1′, 2′-(^{3}H)-COENZYME Q_{10} IN RATS. Katayama, K.; Fujita, T. (Eisai Co. Ltd., Tokyo). Chem. Pharm. Bull. (Tokyo); 20: No. 12, 2582-2592 (Dec 1972).

The intestinal absorption of 1′,2′-(^{3}H)-coenzyme Q_{10} (^{3}H-Q-10) was studied in rats with cannulated thoracic duct, and the effect of surface-active agents on the lymphatic absorption of ^{3}H-Q-10 was determined. The amount of radioactivity absorbed via lymphatics during the first 48 hr was 1% of the dose after oral administration of ^{3}H-Q-10 dissolved in sesame oil or 20 mM sodium taurocholate and was 1.5% of the dose of ^{3}H-Q-10 dissolved by HCO-60. Assuming that the amount of radioactivity recovered from urine (0.481%) and liver (0.004%) might come from the radioactivity absorbed via portal vein, the total amount of the radioactivity absorbed via portal vein and lymphatics was approximately 2% of the dose of ^{3}H-Q-10 dissolved by HCO-60 and the main route in absorption of ^{3}H-Q-10 was lymphatics. The model for lymphatic absorption of ^{3}H-Q-10 was proposed by kinetic analysis of the data. (auth)

10564 METABOLISM OF ^{57}Co-METHYLCOBALAMINE IN RAT AND GUINEA PIG. Kinoshita, K.; Fujita, T. (Eisai Co.

Lt., Tokyo). Chem. Pharm. Bull. (Tokyo); 20: No. 12, 2561-2569(Dec 1972).

The metabolic fate of ^{57}Co-methylcobalamine after oral or intraperitoneal administration to rats and guinea pigs (25 μg/kg) was studied. From fecal excretion test, the intestinal absorption of ^{57}Co-methyl-cobalamine seems to be less than 5% of the dose, and the time course of fecal excretion was different in both species. The fecal excretion in guinea pig was slower and more continuous than in rat. The urinary excretion of radioactivity after intraperitoneal administration was lower in rat (41% of dose during the first 24 hr) than in guinea pig (68%), and the main excretion form in urine was ^{57}Co-methylcobalamine itself in both species. ^{57}Co-methylcobalamine might be stable in the intestinal tract and transferred through the intestinal wall in unchanged form. Tissue distribution of radioactivity after intraperitoneal administration was higher in rat than in guinea pig generally, and the highest uptake in rat was found in the kidney, while the trend of higher uptake in guinea pig was found in the liver. The biological conversion of ^{57}Co-methylcobalamine incorporated in liver and kidney into other cobamide analogs was studied, and it was evident that ^{57}Co-methylcobalamine was transformed to 5, 6-dimethylbenzimidazolylcobamide coenzyme and hydroxocobalamine in both species. (auth)

10565 BODY COMPOSITION IN HUMAN BIOLOGY. Bauer, F. K.; Telfer, N. (Univ. of Southern California, Los Angeles). pp 1-12 of In Vivo Neutron Activation Analysis. Vienna; International Atomic Energy Agency (1973).

From panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972). See STI/PUB-322; CONF-720471-.

The study of body composition is the study in vivo of the chemical makeup of the intact human subject. Much work has been done in this field using radioisotopes in dilution studies. Serious difficulties with subjects, tracers, and samples are met within these investigations. Ideal conditions for exact measurement (absence of isotope effect from differing atomic species, presence of the tracer only in the compartment studied, identity of behavior between tracers and, if necessary, their substitute tracers, accuracy of measurement of unbiased samples), do not always prevail. Nevertheless, valuable information has been obtained regarding water-solute relations and the fat-free body mass or lean body mass. Important advances have been made in the measurement of intra- and extracellular body water and electrolytes. Body sodium studies have revealed a non-exchangeable pool of this element in bone. Body potassium studies and multi-compartment investigations have led to important advances in basic science and medical practice. The information thus made available has benefited patients with renal, pulmonary, and cardiac problems, as well as those needing surgery. Significant work has also been done on hydrogen ion concentration, and on body calcium, magnesium, chloride, and other elements. (auth)

10566 USE OF THREE-PARAMETER MODEL FOR THE FITTING OF EXPERIMENTAL DATA FROM COMPETITIVE PROTEIN-BINDING ASSAYS FOR MEASUREMENT OF STEROID HORMONES. Arrigucci, A.; Calabresi, E.; Fiorelli, G.; Forti, G.; Pazzagli, M.; Serio, M. (Univ., Florence). J. Nucl. Biol. Med.; 17: No. 3, 124-127(1973).

A three-parameter model is described for the fitting of experimental data from competitive protein-binding assays radioimmunoassays for measurement of steroid hormones in the blood of patients. A computer program is described that was developed for performing the calculations required. Using total radioactivity, percent bound (or free) and unlabelled steroid values of the standard curve, the program supplies the concentration of the steroid in the unknown samples corrected for recovery. (CH)

10567 SHORT TERM DETERMINATION OF SERUM ALBUMIN CATABOLISM IN MAN FROM PLASMA DATA ONLY. Bianchi, R.; Mariani, G.; Pilo, A.; Toni, M. G. (Univ., Pisa, Italy). J. Nucl. Biol. Med.; 17: No. 3, 117-118(1973).

A method is described for the assessment of the fractional catabolic rate (FCR) of plasma proteins over a short time interval in man. The method uses simultaneous injection of ^{131}I human serum albumin and ^{125}I sodium iodide; it permits FCR to be determined in 24 hours from measurements of ^{131}I non-protein bound activity in plasma. The experimental difficulties of this measure were solved by gel filtration of plasma samples. (CH)

10568 CONSIDERATIONS ON PRELIMINARY RESULTS FROM TRIIODOTHYRONINE (T_3) CATABOLISM AND DISTRIBUTION STUDIES IN MAN. Vigneri, R. (Univ., Catania, Italy); Pezzino, V.; Pilo, A.; Squatrito, S.; Polosa, P. J. Nucl. Biol. Med.; 17: No. 3, 113-116(1973).

Data are reviewed from studies on triiodothyronine (T_3) peripheral metabolism in man. The analysis of published data in this field does not clear up some doubts regarding the methods and techniques used and the usefulness and meaning of the results reported. Data on the sources of artifactual errors during the measurement of radioiodine-labelled T_3 kinetics in man in which ^{125}I and ^{131}I were used as tracers are discussed and the physiological meaning of the data collected on peripheral thyroid hormone distribution and metabolism in man are summarized. (CH)

10569 DETERMINATION OF SPLEEN WEIGHT FROM POSTERIOR RADIOISOTOPE SCAN. Salvatore, M.; Tarallo, L.; Maligieri, F. (Istituto dei Tumori, Naples). J. Nucl. Biol. Med.; 17: No. 3, 108-112(1973).

The clinical examination of the spleen offers the possibility to determine its dimension with a certain approximation both in the case of splenomegaly or normal spleens, as well as in the case of spleen smaller than the normal ones. Spleen weight, rather than its geometrical dimension, may provide a more rigorous criterion for any evaluation. A method is described for estimation of the spleen weight based on measurements made on ^{99m}Tc-labeled sulfur colloid spleen scans. (CH)

10570 GALLIUM-67 CITRATE IN THE STAGING OF MALIGNANT LYMPHOMAS. Palumbo, R.; Tonato, M.; Martelli, M. F.; Corso, S.; Grignani, F. (Univ., Perugia, Italy). J. Nucl. Biol. Med.; 17: No. 3, 100-103(1973).

Appropriate therapy of malignant lymphomas requires a careful staging, which means an accurate knowledge of the extent of a patient's disease. The diagnostic procedures that can be performed in addition to an accurate clinical study are numerous and include local excision biopsy of lymph nodes, roentgenograms of the chest and skeleton, bipedal lymphography, bone marrow biopsy, exploratory laparotomy with splenectomy and liver and retroperitoneal lymph nodes biopsies. New scintigraphic methods with tumor specific agents (such as ^{67}Ga citrate) have been introduced as part of a routine staging protocol. Experience with ^{67}Ga scanning in 25 patients with various types of lymphomas, 20 of whom did not receive any therapy before the study, is described. (CH)

10571 RESULTS WITH ^{67}Ga-CITRATE IN TUMOR DIAGNOSIS. Caldarola, L.; De Filippi, P. G.; D'Onofrio, M. (Istituto de Oncologia, Turin). J. Nucl. Biol. Med.; 17: No. 3, 97-99(1973).

Results are reported using radioisotope scans with ^{67}Ga-citrate in 250 neoplastic patients examined during a period of about 18 months. In all 250 cases diagnosis was confirmed by biopsy, intraoperatively, or at necropsy. Fifteen subjects with benign lesions of the lungs were also studied. (CH)

10572 JOINT SCAN IN HAEMOPHYLIC ARTROPATHY. Masi, R.; Pieroni, C.; Morfini, M.; Rossi Ferrini, P. L. (Univ., Florence). J. Nucl. Biol. Med.; 17: No. 3, 104-107(1973).

The inflammatory involvement of synovial tissue may be demonstrated by joint scans with ^{99m}Tc-pertechnetate. Scintigraphic techniques were employed for diagnosis and clinical evaluation of therapy in various atrophies. The method was used for the demonstration of hemophylic atrophy in patients, even when inflammation did not play the primary role. Together with joint visualization, a quantitative evaluation of synovial involvement was possible. This was useful especially for patients followed up with repeated scan recordings. The diagnostic value of joint scans in hemophylia is based on two considerations. The early histopathological alterations of hemophylic atrophy take place in synovial tissue and play a primary role in the pathogenesis of synovitis, and the radiological examination is able to demonstrate only the late involvement of cartilage and bone. The senstivity of the technique was high enough to demonstrate several cases of synovitis unsuspected by the clinical history and examination. (CH)

10573 AUTOMATIC TREATMENT OF RADIOIMMUNOASSAY DATA. Rolleri, E.; Novario, P. G.; Pagliano, B. (CNR, Saluggia, Italy). J. Nucl. Biol. Med.; 17: No. 3, 128-141(1973).

Programs for the treatment of the radioimmunoassay data have been set up for both high-speed and desk-top computers, taking into account the requirements of routine measurements (few calibration points and few replicates). The model used is based on the logit-log transformation of the dose-response curve. The assumptions and the simplifications made are discussed, and some features of the programs are compared. (auth)

10574 INVESTIGATION OF CEREBRAL CIRCULATION WITH ^{133}Xe INHALATION IN CLINICAL PHARMACOLOGY. Vorob'eva, Z. V. Med. Radiol.; 18: No. 11, 77-79(Nov 1973). (In Russian).

A modification of the usual method of making the subject test is described in which the subject lies on a couch, instead of sitting up for 30 to 60 min, after inhaling ^{133}Xe, the counter being placed on the forehead instead of on the occipital region. The method was tested in five men with cerebral disturbances (six normal men and three women as controls). The results correlated well with those of the usual test. The modification is less tiring to the subject and the ^{133}Xe is more readily washed out. (TTT)

10575 INTRACAVITARY AREA SCANNER: BETA-RAY IMAGING DEVICE FOR EXAMINATION OF THE EARLY UTERINE CANCER. Takizawa, M. (Shinshu Univ., Nagano, Japan); Ando, T.; Iwai, S.; Sonehara, M.; Noguchi, H. Radioisotopes (Tokyo); 22: No. 8, 440-447(Aug 1973). (In Japanese).

Using a semiconductor catheter detector of the side window type for β particles, an apparatus to elicit radioisotope image by intracavity area scanning was made for testing. This apparatus enables a distance of 0 to 15 cm to be scanned, and by rotating 10° in every scan moving in close contact with the mucosal surface of the cavity, it is possible to observe incorporation of radioisotopes under the condition of extended lumen. Output from the scanner is processed by means of a small computer, and is recorded by an X-Y recorder, to observe the results in a diagram as well as to avoid statistical errors to be made on account of low uptake rate. This scanner was applied to diagnosis for decision of localization of the early uterine cancer with ^{32}P. Comparing the results with the pathohistological findings of conization or operated specimen, it was recommendable for diagnosis of the degree of spreading cancer on the mucosal surface quantitatively. (auth)

10576 ACCUMULATION OF RADIOACTIVITY IN THE OOCYTE FOLLOWING ^{125}I-FSH ADMINISTRATION. Presl, J.; Pospisil, J.; Figarova, V. Cesk. Gynekol.; 38: No. 5, 368-370(Jun 1973). (In Czech).

An accumulation of reduced silver grains was demonstrated in the peripheral cytoplasm of tertiary follicle oocytes by means of ovarian autoradiography 2 hrs after a single intravenous injection of ^{125}I-FSH in immature rats. Following ^{125}I-HCG or ^{125}I-bovine serum albumin administration a similar radioactivity uptake has not been observed. Therefore, FSH uptake by tertiary follicle is suggested, and a role of gonadotropins in preovulatory activation of meiosis was discussed. (auth)

10577 CLINICAL AND DOSIMETRIC STUDY OF THE EVOLUTION OF THE RESIDUAL CONTAMINATION OF THE ENCEPHALON FOLLOWING AN INJECTION OF ^{169}Yb-LABELED DTPA SOLUTION INTO THE CEPHALO-RACHIDIAN LIQUID. Zerbib, J. C. (CEN de Saclay, Gif-sur-Yvette, France); Imbert, L.; Bonleu, M.; Joffre, H.; de Tovar, G.; Beaufils, F.; Collonge, M. Radioprotection; 8: No. 1, 1-17(1973). (In French).

A large uptake of ^{169}Yb-labeled DTPA was observed following an occipital injection. The activity of the ^{169}Yb fixed in the cerebral mass was measured using spectrometry and the absorbed dose was evaluated by implanting lithium fluoride detectors in a phantom. An autoradiography demonstrated that the diffused product selectively fixes itself near the ventricle walls. (FR)

MATERIALS

10578 (GA-9118) HIGH-TEMPERATURE CERAMIC-TO-METAL SEAL DEVELOPMENT. Chin, J.; Messick, C. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). 10 Feb 1969. Contract AT(04-3)-167. 66p. Dep. NTIS $5.50.

Declassified 5 Jun 1973.

A ceramic-to-metal seal was developed capable of operation up to 1200°C in a cesium environment. A new metallizing technique based on a promising tungsten–yttria system reported by LASL, was studied. Effects of mixture age, delay time between metallizing and brazing, and high-temperature outgassing were measured and found critical to the final joint strength. Seals were prepared by brazing metallized Lucalox to niobium with a 60 vanadium–40 niobium braze alloy. A complex braze thermal history was required for a high-strength joint. A seal coat was developed which inhibits corrosive interaction between the braze alloy and alumina at high temperatures. With careful control of metallizing and brazing techniques, room-temperature joint strengths equivalent to or better than early 700°C seals were obtained. Seals were subjected to thermal stability and cesium corrosion proof tests; they remained leak tight. (40 figures) (auth)

Ceramics and Cermets

Refer also to abstracts 9763, 9765, 10326, 10640, 10661, 10668, 10688, 10690, 10711, 11790, 11811, 11858, 11874, 11876, 11984, 11985, 12443, 12446, 12458, 12481, and 12491.

10579 (AAEC/E-250) ASSESSMENT OF SOME ORGANIC BINDERS FOR THE FABRICATION OF URANIUM DIOXIDE FUEL PELLETS. Ramm, E. J.; Webb, C. E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Dec 1972. 38p. Dep. NTIS (U.S. Sales Only) $4.00.

Uranium dioxide fuel pellets for water-cooled reactors are usually made by cold pressing and sintering UO_2 powders with or without an organic binder. A wide range of binders was assessed and the most suitable was Cranco 253 (poly-butylmethacrylate). Other binders such as polyvinyl alcohol, zinc stearate, and Sterotex showed promise, but further optimization of their level and method of addition and of the debonding and sintering procedure is necessary. (auth)

10580 (CEA-CONF-2238) IN-PILE BEHAVIOR OF UO_2–Mo CERMETS. Francois, B.; Chenebault, P.; Kauffmann, Y.; Stora, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1972. 19p. (In French). (CONF-720613-6). Dep. NTIS (U. S. Sales Only) $3.00.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Within the framework of a program for the development of nuclear fuels for thermoelectric conversion, irradiations were made of dense UO_2–Mo cermets. These cermets consisted of UO_2 granules of approximately 500 μ encased in a Mo matrix. The UO_2/Mo ratio is $^2/_3$ in volume and the UO_2 enrichment is 20%. Results are reported from three experiments. In Ambre I, unclad tablets were irradiated for 3700 h between 1400 and 1650°C to a burnup of 7.6×10^{19} fissions/cm^3 of cermet. The fission gases escaping from the fuel were sampled and analyzed. In Cythere 0, two fuel elements sealed in Mo each contained a cermet tube. One of the elements was irradiated to a surface temperature of 1659°C. After 600 h of test or 3.5×10^{19} fissions/cm^3 of cermet, the neutronography examination showed that this fuel had swollen by 30% of its initial volume, with most of the deformation being produced toward the interior of the tube. Under analogous conditions the second element placed at a surface temperature of 1350°C underwent no evolution. In Cythere I, an analogous cermet tube was irradiated in a ventilated element connected to a system for the analysis of fission gases and placed at a surface temperature of 1550°C. After 1100 h in the reactor, when the fraction of ^{85}Kr released was close to 10%, neutronography showed the beginning of swelling in the cermet analogous to that observed in Cythere 0. Metallographic examinations after irradiation gave indications on the possible swelling mechanisms of this type of cermet. A critical analysis of the results led to the conclusion that, in spite of its dimensional instability, this type of fuel should not be rejected for thermoelectric elements. (tr-auth)

10581 (CEA-CONF-2306) TECHNIQUES FOR SAMPLING AND ANALYSIS FOR THE IN-PILE STUDY OF THE MIGRATION OF FISSION GASES IN CERAMIC FUELS. Chenebault, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 15 Mar 1972. 22p. (In French). (CONF-720566-2). Dep. NTIS (U. S. Sales Only).

From twenty-first meeting of the Euratom working groups on irradiation facilities; Juelich, Federal Republic of Germany (4 May 1972).

Different techniques were utilized to study, in-pile, the release of fission gases from uranium dioxide-based fuels. Small samples were placed in furnaces heated electrically or nuclearly. They could be maintained almost homogeneously at a temperature between 400 and 2000°C. The released fission gases were entrained continuously by a current of purified helium. They were trapped and then analyzed by γ spectrometry (NaI and GeLi detectors). All the active isotopes with half life above 14 min were measured. The gases released by a rod containing UO_2 or a UO_2-based or $(U,Pu)O_2$-based pin were analyzed at different power and temperature levels representative of the operational conditions of industrial fuel elements. The samplings were made discontinuously by sweeping the free volume placed at the extremity of the fissile column. The radioactive gases with half life higher than 14 min were measured by γ spectrometry, and the stable gases were measured by mass spectrometry and gas-phase chromatography. The gases liberated by a fuel pin were entrained continuously by a circulation of purified helium. The fissile column could be swept from part to part or there could be a single sweep of the end of the pin. The total gaseous activity released was measured continuously. In the automatically sampled samples the isotopes with half life $\geq$ 3 min were analyzed by measuring separately Kr and Xe (chromatographic separation) by γ spectrometry. The stable gases corresponding to accumulation periods of several days or released in transitory regime were measured by gas-phase chromatography or by mass spectrometry. (tr-auth)

10582 (CONF-720613-P2, pp 765-782) PHYSICAL-MECHANICAL PROPERTIES OF BERYLLIUM OXIDE AND INVESTIGATION OF ITS ELECTRICAL RESISTANCE UNDER IRRADIATION IN A REACTOR. Gorelov, I. N.; Drozhshin, V. A.; Zasorin, I. P. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The physical-mechanical properties of beryllium oxide, their dependence on temperature and density, and data concerning ceramics texture dependence on technological factors are given. Methods and results of reactor irradiation influence on electric conductivity of the beryllium oxide using in-reactor measurements during irradiation are described. The measurements were carried out under direct current in the temperature range of 200 to 700°C in neutron fluxes 4×10^{-12} to 10^{-14} neutron/cm^2 sec (E < 0.1 MeV) and γ quanta from 10^{12} to 2.5×10^{13} photon/cm^2 sec. Results showed that specific volumetric resistance of the beryllium oxide at the initiation of irradiation decreased from (4 to 18) $\times$ 10^{12} ohm/cm to (3 to 8) $\times$ 10^{11} ohm/cm with a temperature rise and neutron flux rise. With temperature rise the irradiation influence on specific volumetric resistance decreases. During the experiment the integral dose of 1.2×10^{21} neutron/cm was accumulated. (auth)

10583 (CONF-720613-P2, pp 783-796) INVESTIGATION OF THE PROPERTIES OF ELECTRODE MATERIALS MADE ON THE BASIS OF HIGH-MELTING-POINT COMPOUNDS AND ALLOYS. Samsonov, G. V.; Podchernyaeva, I. A.; Fomenko, V. S.; Okhremchuk, L. N.; Siman, N. I.; Kunitskii, Yu. A. (Inst. for Material Problems, Kiev). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In order to evaluate the possibilities of using high-melting-point compounds and alloys as electrode materials in thermionic converters, the carbide and boride phases of transition metals in the IV–VI groups of the periodic table were studied along with compounds consisting of tungsten- or rhenium-base alloys with rare earths. The thermionic emission characteristics of these materials in vacuum and their absorption and thermionic emission properties in a cesium medium have been studied. The absence of chemical interaction between borides and carbides on the one hand and cesium vapors on the other hand could be shown. From the experimental results obtained and from subsequent discussions, and considering the properties of the electronic structure of the ma-

terials being studied, recommendations have been made regarding their possible use in thermionic converters. (auth)

10584 (CONF-720613-P2, pp 819-830) EFFECT OF FAST-NEUTRON IRRADIATION ON ALUMINA AND YTTRIA. Ranken, W. A.; Frank, T. G.; Keilholtz, G. W. (Los Alamos Scientific Lab., NM). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Thin-walled and solid cylinders of commercially available alumina as well as thin-walled cylinders of yttria were irradiated in the Experimental Breeder Reactor to a maximum fast-neutron ($E_n > 0.1$ MeV) fluence of 9.8×10^{21} n/cm^2 at temperatures ranging from 500 to 1200°K. Macroscopic volume changes as large as 10.5% at 7×10^{21} n/cm^2 were observed for alumina specimens containing silica and calcia in the grain boundaries. However, specimens with high purity and small grain size exhibited about two-thirds less swelling at the same fluence. Results of modulus-of-elasticity and vacuum-integrity determinations indicate that for a volume increase of 3% the modulus decreases by almost 50%, and the probability of vacuum leakage is high. Yttria specimens of both 4- and 40-μm average grain size suffered no dimensional increase and no apparent change in the modulus of elasticity. The results are discussed in terms of their significance to thermionic reactor design. (auth)

10585 (CONF-720613-P2, pp 831-843) EFFECT OF NEUTRON SPECTRA ON THE SWELLING OF CERAMIC INSULATORS AND IMPLICATIONS FOR THERMIONIC REACTOR DESIGN. Frank, T. G.; Backus, C. E. (Los Alamos Scientific Lab., NM). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Data on swelling and loss of vacuum integrity of alumina due to neutron irradiation are now available for several neutron spectra. A neutron-energy-dependent model for predicting relative numbers of neutron-induced atomic displacements in alumina in different neutron spectra is presented which correlates the available swelling data reasonably well. The model has been extended to yttria and magnesia. It is shown that neutron fluence, $E_n > 0.1$ MeV, is an adequate parameter for use in practical applications for predicting relative numbers of neutron-induced atomic displacements in each of the three materials. The implications of neutron-induced damage to ceramic insulators for thermionic reactor design are discussed, and core designs optimized for minimum neutron damage to in-core ceramic insulators at constant core electric power density are described. (auth)

10586 (CONF-720613-P2, pp 861-871) EXPERIENCE DURING MANUFACTURING THE CORE FOR THE ITR CRITICAL EXPERIMENT. Cheliotis, G. (Siemens AG, Erlangen, Ger.); Gregorius, K.; Peehs, M.; Schoerner, H.; Paetz, P. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The construction of the thermionic fuel elements (TFE) and fuel moderator rods (FMR) for the ITR critical experiment is described. The techniques introduced for the fabrication of the rods have been proven and are compared with those of the prototype. By grinding with diamond disks the metal hydrides YH_x and $UZrH_x$ can be machined to close tolerances. The spark erosion process was successfully employed for drilling channels in the thermionic fuel element for neutron flux measurement. (auth)

10587 (CONF-720613, P2, pp 873-883) MATERIAL DEVELOPMENT FOR THERMIONIC FUEL-CLADDING SYSTEMS. Yang, L.; Hudson, R. G.; Johnson, H.; Horner, H.; Allen, D. T. (Gulf General Atomic Co., San Diego, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Work carried out during the past decade on thermionic fuel-cladding development has indicated that the uranium carbide–tungsten and the uranium oxide–tungsten systems are promising candidates. Materials were developed to meet the requirements of the thermionic fuel element. Out-of-pile and in-pile studies of fuel-cladding compatibility, dimensional stability, and thermionic performance stability were performed for both fuel-cladding systems. The status of the development is described. (auth)

10588 (CONF-720613-P2, pp 911-925) SOME OBSERVATIONS ON URANIUM CARBIDE ALLOY/TUNGSTEN COMPATIBILITY. Phillips, W. M. (Jet Propulsion Lab., Pasadena, CA). 1972

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Chemical compatibility tests between both pure tungsten and thoriated tungsten were run at 1800°C for up to 3300 hours with uranium carbide alloys. Alloying with zirconium carbide appeared to widen the homogeneity range of uranium carbide, making additional carbon available for reaction with the tungsten. Reaction layers were formed both by vapor phase reaction and by physical contact, producing either or both UWC_2 and W_2C, dependent upon the phases present in the starting fuel alloy. Formation of UWC_2 results in slow growth of the reaction layer with time, while W_2C reaction layers grow rapidly, allowing equilibrium to be reached in less than 2500 hours at 1800°C. The presence of a thermal gradient had no effect on the reactions observed, nor did the presence of thoria in the tungsten clad. (auth)

10589 (CONF-720613-P2, pp 927-944) BEHAVIOR OF TUNGSTEN-CLAD Mo–UO_2 FUEL UNDER NEUTRON IRRADIATION AT HIGH TEMPERATURE. Ranken, W. A.; Reichelt, W. H. (Los Alamos Scientific Lab., NM). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Specimens of Mo–40 vol % UO_2 cermet reactor fuel, lightly clad with CVD tungsten, have been irradiated for times varying from 2300 to 10,400 h at temperatures of 1700 to 2140°K. Fission-power densities in the fuel varied from 216 to 365 W/cm^3. Maximum burnup was 3.6×10^{20} fissions/cm^3 of cermet. Measurements of dimensional change occurring as a result of irradiation show that dimensional stability is increased by constructing the cermet so that interconnected porosity exists throughout the specimen. The rate of diametral increase of porous cermet specimens was ~1.6% per 10^{20} fissions/cm^3 at 1950°K, but decreased markedly with decreasing temperature. Extensive measurements were made to determine the location of gaseous fission products subsequent to irradiation. These included direct measurements of fission-gas release and measurements of the amount of fission gas retained in both the molybdenum and UO_2 phases of the cermet. Krypton-85 and ^{137}Cs release fractions as high as 80% were observed. Scanning-electron-microscope observations indicate that fission gas introduced into the molybdenum phase by recoil collects in bubbles up to 0.8 μm in diameter. The percentage release from the molybdenum phase is small. The data are discussed in terms of the applicability of the cermet fuel form to thermionic emitter construction. (auth)

10590 (CONF-720613-P2, pp 963-978) RELEASE OF FISSION PRODUCTS FROM HIGH-TEMPERATURE FUEL MATERIALS. Ponomarev-Stepnoi, N. N.; Khrulev, A. A. (Kurchatov Inst. of Atomic Energy, Moscow). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

An activation model of gaseous fission products release from the high-temperature fuel is suggested. This model is based on an analysis of results of fuel-annealing experiments under different conditions (during and post in-pile irradiation). The products of nuclear reactions (fission and decay nuclei) are supposed to diffuse into fuel defects (point defects, clusters, and structure defects). The energy distribution of defects depends on the fuel prehistory (irradiation and storage conditions). The fission products can escape from the initial defects due to thermal oscillations, body cracks, growing grains, etc. The intensity of these processes is determined by the temperature condition during the tests. Additional ways for fission products escaping are radioactive decay and the "knockout" effect. The fission products diffusing from the initial defects are collected on a surface and partially on defects with higher activation energies. At high temperatures the total rate of migration and the rate of release of gaseous products from the fuel is determined by the annealing rate of the defects. (The rate of desorption is supposed to be much higher). On the basis of this model the parametric set of equations for determining both the amount of fission products accumulated within the fuel and the rate of gaseous products evaporation from the fuel are derived. For the cyclic tests measurements of Kr and Xe release from UO_2, UC_2 + C, and UP were made during and after irradiation in the step-like and continuous fuel heating and cooling regimes. By applying the derived equations and the obtained experimental results, the dependence of gas-release parameters on the temperature was determined. The range of the temperature variation was from a few hundred °C to the fuel melting points. (auth)

10591 (CONF-720613-P2, pp 1015-1026) INVESTIGATIONS CONCERNING METAL HYDRIDE TECHNOLOGY AND HYDROGEN TRANSPORT IN THE INCORE THERMIONIC REACTOR (ITR)-CORE. Duenner, P.; Jung, J. (INTERATOM, Bensberg, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

With regard to the development of production technology for ITR fuel–moderator or moderator materials, metallurgical investigations of the metal hydride systems Y–H, Zr–H–U and Y–H–U were performed. In particular, it was possible to fabricate fuel–moderator or moderator elements without cracks or surface defects and with as near a homogeneous hydrogen and uranium distribution as possible. For proper hydriding, knowledge of the partial pressure of hydrogen as a function of both the temperature and the hydrogen content of the hydride was necessary. For this purpose experiments have been carried out in a Sievert's apparatus. In the thermionic element of the ITR, low hydrogen partial pressures are required, which necessitated investigations concerning hydrogen transport. The kinetics of dehydrogenation of ZrH_x and YH_x was measured in vacuum; the results show that the hydrogen loss of the 650°C ZrH_x isotherm lies in the range of the 825°C YH_x curve. The hydrogen permeation through an austenitic cladding steel was determined in an arrangement that uses YH_x as the hydrogen source; the measurements were carried out at 750 to 900°C. An effective lowering of the H_2 partial pressure in the thermionic diode gap can be achieved by hydrogen purification of the sodium. Laboratory experiments with yttrium as a solid getter material were carried out and yielded, from the kinetic viewpoint, good purification efficiency also. Experiments with H_2-permeable nickel membranes showed that long pumping times and large surface areas are necessary for reactor operation. (auth)

10592 (CONF-720613-P3, pp 1423-1433) ELECTRON WORK FUNCTION CHANGE OF INTERSTITIAL COMPOUNDS OF THE 4a AND 5a METALS IN DEPENDENCE ON THE NONMETAL CONTENT. Haufler, G. (Univ., Stuttgart); Goretzki, H.; Jucker, J. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The thermionic emission constants ϕ and A_R were measured in the systems Zr–O, Zr–B, Zr–C, Ta–O, Nb–C, Zr–Ta–C, and Zr–Nb–C. The systematic investigations cover the whole range of the nonmetal concentration in which the metallic character of these compounds exists. The results are discussed with respect to the electron band structure of the refractory materials. (auth)

10593 (COO-1109-71) PSEUDOPHASE BEHAVIOR IN THE EPSILON AND IOTA REGIONS OF THE PRASEODYMIUM OXIDE–OXYGEN SYSTEM. Turcotte, R. P.; Jenkins, M. S.; Eyring, L. (Arizona State Univ., Tempe (USA)). 1973. 65p. Dep. NTIS $5.25.

Besides line and nonstoichiometric phases, complex oxide systems exhibit reproducible bivariant behavior, termed pseudophases, in the two-phase regions which lead to hysteresis. Two of these pseudophases in the praseodymium oxide–oxygen system are examined in detail by tensimetric and high temperature x-ray studies. The tensimetric measurements show marked and progressive shifting of the curves away from stoichiometry with increasing pressure. In addition, unusual reversals are seen to occur both in oxidation and reduction. X-ray-diffraction patterns at temperature are seen to show systematic changes in line positions and line widths. These are analyzed and their implications discussed in terms of suggested structural changes. Similarities and relevance to other systems are discussed. (auth)

10594 (EIR-230) PLUTONIUM FUEL PROGRAM ANNUAL REPORT, 1972. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Apr 1973. 57p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

The plutonium fuel program was concerned with three areas of fuel development: preparation and characterization of the fuel, irradiation in the reactor to the highest possible burnup, and investigation of the changes occurring during the irradiation as a result of fission. Studies on the gelling process in the KEMA U(VI) method included the gel rate in dependence on three fuel variables and the determination on the crystal habit of uranium oxide in this process. The production of acid-free concentrated Pu(IV) nitrate solutions was studied with respect to the properties of crystalline Pu(IV) nitrate and depolymerization of polymer Pu in HNO_3. A series of microspheres of (U, Pu)C and $(U,Pu)O_2$ were prepared by the spray nozzle method. The sol/solvent surface and the film elasticity were studied. The preparation of carbides from the green gel material, analysis and characterization of the carbides, and studies on the carbide compatibility and phase transformation kinetics are discussed. The irradiation conditions in FILOS, DIDO, and BR-2 are described. The results of studies on vibration packing of the oxides and dummy materials are reported. The post-irradiation study of the third FILOS test element is described. Software was developed for the HP2116B small computer for γ spectrometry and γ scanning. A tabulation of the publications and reports published during the year is given. (JSR)

10595 (HEDL-SA-578) BORON CARBIDE THERMAL CONDUCTIVITY. Mahagin, D. E.; Bates, J. L.; Baker, D. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1973. Contract AT(45-1(-2170). 29p. (CONF-731041-5). Dep. NTIS $3.50.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

The thermal conductivity of boron carbide as affected by neutron irradiation was studied. The dominant heat transport mode at temperatures between 16 to 1400°C is a phonon mechanism. The conductivity is inversely proportional to temperature above 225°C. Porosity has a moderately strong, nonlinear effect on the thermal conductivity. A modified Maxwell–Eucken correction factor describes the dependence adequately. Neutron irradiation reduces the thermal conductivity significantly. The loss saturates rapidly and is inversely proportional to irradiation temperature. It is apparently due to lattice damage in the solid, principally the formation of point defects which serve as phonon scattering centers. (14 figures, 24 references) (auth)

10596 (HEDL-SA-592) ROOM-TEMPERATURE OXIDATION OF $(U,Pu)O_{2-x}$. Woodley, R. E.; Gibby, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 42p. (CONF-731041-6). Dep. NTIS $4.25.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

The room-temperature oxidation of a hypostoichiometric mixed-oxide fuel, $U_{.75}Pu_{.25}O_{2-x}$, was studied by three experimental techniques. It was determined that water vapor is an effective oxidant, but molecular oxygen apparently is not. Moisture enters the fuel pellet by means of surface-connected microcracks. The extent of oxidation and hence the increase in the bulk O/M of the pellet depend upon the surface area available to the oxidant. Only a thin layer on the surface actually undergoes oxidation. The rate of oxidation depends upon the water vapor concentration, the magnitude of accessible surface area, and the degree of substoichiometry. At water vapor concentrations below a few vpM, the rate becomes first order with respect to the water vapor concentration, whereas at higher concentrations the rate becomes independent of the water vapor concentration. (auth)

10597 (HEDL-TME-73-78) BORON CARBIDE THERMAL CONDUCTIVITY. Mahagin, D. E.; Bates, J. L.; Baker, D. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 64p. Dep. NTIS $5.45.

The thermal diffusivity of hot-pressed boron carbide pellets was measured at temperatures between 16 and 1400°C using a "flash" technique. Thermal-conductivity values were calculated from the diffusivity measurements. Empirical porosity correction factors were determined for both properties. Measurements on pellets irradiated at temperatures between 500 and 870°C showed significant reduction of both the thermal diffusivity and conductivity. The irradiation-induced decreases saturated rapidly (at boron depletion levels of $\sim 5 \times 10^{20}$ captures/cm^3) and were greatest in the pellets exposed at the lowest temperature. The losses are attributed to lattice damage in the boron carbide, principally the formation of defects that serve as phonon scattering centers. (auth)

10598 (JUL-969-RW) ABOUT DEVELOPMENT OF A MATRIX MATERIAL FOR PRODUCTION OF PRESSED FUEL ELEMENTS FOR HIGH-TEMPERATURE REACTORS. Hrovat, M.; Nickel, H.; Koizlik, K. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). Jun 1973. 98p. (In German). Dep. NTIS (U.S. Sales Only) $7.00.

The development and optimization of a graphitic matrix material, which is used in the production of pressed fuel elements for gas-cooled high-temperature reactors is described. Optimization is done with regard to the mechanical, thermal, and reactor-physical attributes of the material. The end-product, the standard-A3 matrix, meanwhile found a common usage because of its excellent availability and its satisfying facilities in irradiation tests. To get a technological interesting production line, a method of manufacture, suited to the new matrix material, is described. It is the so-called isostatic pressurizing, which is not only suitable for the production of spherical fuel elements but also for prismatic fuel elements. (26 figures, 41 references) (auth)

10599 (JUL-989-RW) URANIUM CONTAMINATION IN PYROLITIC CARBON BY THE PRODUCTION OF COATED PARTICLES WITH OXIDE FUEL. Wallura, E. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). Aug 1973. 109p. (In German). Dep. NTIS (U.S. Sales Only) $7.50.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The origin of the uranium concentration in pyrolitic carbon, which is deposited on spherical UO_2 fuel kernels is examined. Uranium-concentration profiles were measured in the outer pyrolitic carbon layer (HDI) by successive mechanical removing and fluorimetric analysis. According to the distribution of the uranium concentration in the layer, and according to annealing tests, it was possible to exclude a contamination of the layer by Fick's diffusion of uranium through the coating of the oxide nuclear fuel. It was found that, during the deposition, uranium from the gas phase is stored up in the growing outer pyrolitic carbon layer. The uranium can evaporate into the coating area from the contaminated walls of the coating pipe and from fuel kernels, which are exposed during the deposition of the HDI layer. With a model coating test at 2000°C, according to these results it was possible to drop the average uranium concentration in the HDI layer to a value of 2×10^{-6} g U/g PyC. (auth)

10600 (KFK-EXT-6/73-3) STRUCTURE, PREPARATION, AND PROPERTIES OF REFRACTORY COMPOUNDS AND SYSTEMS. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Aug 1973. 40p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

Since early 1973 IMF has been carrying out studies on the structure and properties of refractory compounds and systems. These studies have evolved from the work done for some years at the Institut fuer Werkstoffkunde II of the University of Karlsruhe in the field of carbides, nitrides and carbonitrides of the transition metals and their combination with metals (Co, Ni, etc). In this first semiannual report, after a short introduction and description of the subjects under study, the work carried out by the Institut fuer Werkstoffkunde II is summarized. The work in progress at the IMF is then described in greater detail. (GE)

10601 (ORNL-tr-2732) DEVELOPMENT OF COATED FUEL PARTICLES FOR INCREASED POWER AND SAFETY REQUIREMENTS. Foerthmann, R.; Gyarmati, E.; Hilpert, K. Translated by M. Gerrard from Atomwirt., Atomtech.; 17: No. 5, 265-267 (1972). 5p. Dep. NTIS $3.00.

For both high-temperature reactors with a helium turbine in the primary circuit and process steam reactors with high cooling temperature, the release of fission products by coated fuel particles was studied. In oxide fuel particles, strontium and barium were bound through the addition of aluminum oxide or zirconium oxide. At 1400°C, almost all of the barium was bound by the Al_2O_3 phase. At 1700°C, barium increasingly diffused out of the Al_2O_3 phase and back into the UO_2 phase. As coatings for fuel particles, pyrocarbon and silicon carbide were studied. Results showed that the structure of SiC played a major role. At radiation temperatures from 1150 to 1350°C and a burnup of 6%, solid fission products penetrated low-density SiC, while it was retained by high-density SiC. (HBG)

10602 (ORNL-tr-2733) STATIONARY AND DYNAMIC DEPOSITION OF SILICON CARBIDE ON COATED FUEL PARTICLES. Gyarmati, E.; Nickel, H. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany)). Nov 1972. Translated by R. Gregg Mansfield from JUL-900-RW. 57p. Dep. NTIS $5.00.

Silicon carbide (SiC) was deposited on fuel in loose packed particles and in the fluidized bed of monomethyltrichlorosilane (MTS). The deposition in loose packed particles led to porous compacts (loose bondings). It was found out that an exact deposition at 1550°C is only achieved if the MTS is led over a section of prepyrolysis and the heating zone is conducted over the loose packed particles with increasing velocity. The dynamic deposition of SiC occurred in the atmosphere of H_2, H_2/Ar, and H_2/N_2 in the temperature region of 1300 to 1700°C in a fluidized bed of 2 to 3 inches. While the efficiency strongly depends on the deposition temperature and shows a maximum at 1500°C, it was impossible to find a direct relation between the efficiency and the kind of carrier gas. The density of SiC deposited in a pure H_2 atmosphere between 1400 and 1700°C is ≥ 3.2 g/cm^3 and shows a maximum at 1500°C. Thus, an increasing deposition temperature and a decreasing H_2 content of the fluidizing gas have as their consequence a decrease of density. In the absence of H_2 in the fluidizing gas, a material developed similar to that of pyrocarbon (PyC), the so-called "siliconized pyrocarbon"; it reached values of density between 2.25 and 3.10 g/cm^3 according to the conditions of deposition. As was shown by studies on macrostructure, the SiC deposited in a pure H_2 atmosphere is always crystalline. The macrostructure becomes fine-crystalline when small amounts of Ar are added to the carrier gas; higher amounts of Ar produce transition structures to PyC. Nitrogen instead of Ar effects a pore-rich macrostructure. The siliconized PyC is a badly orientated material which probably contains Si in form of SiC, which is dispersively distributed in the PyC matrix. (32 figures, 76 references) (auth)

10603 (RD/B/N-2616) ADDITIONAL DATA ON THE BURNABLE POISON Gd_2O_3/Al_2O_3, AND THE COMPOUND $GdAlO_3$. Noden, J. D. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

Chemical and physical properties of the burnable poison Gd_2O_3/Al_2O_3, developed for Mk III helium-cooled high-temperature reactors are presented. Long-term tests, of 10,000 h have shown the ceramic poison to be compatible with graphite at temperatures as high as 1100°C. It is also compatible with the gaseous impurities normally present in the reactor, e.g., CO_2, CO, H_2O, H_2, CH_4, etc, at normal reactor temperatures. The poison material is extremely inert and does not react with air up to 1100°C. It should therefore behave satisfactorily under severe fault conditions. In this respect its behavior under fault conditions, such as air or steam ingress to the reactor, is superior to the alternative poison, boron carbide. The thermal conductivity of Gd_2O_3/Al_2O_3 has been determined at 60 to 1000°C. Gadolinium aluminate, $GdAlO_3$, is a reaction product present in the fabricated burnable poison ceramic. Thermal expansion, thermal conductivity, and chemical properties of $GdAlO_3$ have also been determined. (auth)

10604 (UCRL-51463) COMPATIBILITY OF BORON NITRIDE IN LITHIUM SYSTEMS. Morris, A. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Oct 1973. Contract W-7405-eng-48. 8p. Dep. NTIS $4.00.

A compatibility test procedure was developed to study the reactions between lithium, refractory metals, and insulating ceramics. In the first series of tests, boron nitride was found to be completely dissolved by lithium in 600 h at 1270K. The refractory metals were borided, and the nitrogen went into solution in the lithium. The results are interpreted from a thermochemical standpoint. (auth)

10605 SPIN-LATTICE RELAXATION OF Mo^{5+} IONS IN $LaNbO_4$ SINGLE CRYSTALS. Kurkin, I. N.; Chirkin, Yu. K.; Shlenkin, V. I. (Kazan State Univ.). Sov. Phys. Solid State (Engl. Transl.); 14: No. 9, 2348-2351(Mar 1973).

Translated from Fiz. Tverd. Tela; 14: No. 9, 2719-2723 (Sep 1972).

The spin–lattice relaxation time of Mo^{5+} ions in $LaNbO_4$ single crystals was measured at frequencies of 9 and 15 GHz/sec in the temperature range 1.5 to 250°K. The Debye temperature of the $LaNbO_4$ crystal was determined as $\Theta \approx 210$°K from the temperature dependence of the probability of the Raman process. (auth)

10606 POOLE–FRENKEL EFFECT IN β RHOMBOHEDRAL BORON. Berezin, A. A.; Zaitsev, V. K.; Kazanin, M. M.; Tkalenko, E. N. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 9, 2445-2446 (Mar 1973).

Translated from Fiz. Tverd. Tela; 14: No. 9, 2813-2815(Sep 1972).

The current–voltage characteristics of single crystals of pure β-rhombohedral B were investigated at 77 to 293°K in fields up to 60 kV/cm. It is shown that the results can be explained on the basis of the Poole–Frenkel effect, assuming the existence of trapping levels associated with Coulomb-type centers whose fields are screened appreciably by free carriers. (DLC)

10607 ELECTRON SPIN RESONANCE OF Gd^{3+} IN $CsEu(MoO_4)_2$ AND $CsY(MoO_4)_2$. Otko, A. I.; Pelikh, L. N.; Zvyagin, A. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2918(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3454-3455(Nov 1972).

The ESR spectra were measured at room temperature in crystals grown by crystallization from melt. Both compounds belong to the D^3_{2h}-Pccm Fedorov group. A single orthorhombic spectrum of Gd^{3+} was observed, in agreement with the structure. The spin Hamiltonian parameters were determined and are tabulated. The spectral lines were strongly broadened when the magnetic field deviated from the axes of the centers. (DLC)

10608 ELECTRO-OPTIC EFFECT IN V_2O_5 SINGLE CRYSTALS BELOW THE FUNDAMENTAL ABSORPTION EDGE. Mokerov, V. G.; Sigalov, B. L. Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2875-2879(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3405-3412(Nov 1972).

The electro-optic effect in V_2O_5 was discovered and investigated below the fundamental absorption edge. The electroreflection spectrum had two sharp maxima at photon energies of 1.25 and 1.56 eV. The electroreflection and conventional absorption spectra and their dependences on the direction of the polarization vector of light were compared. An analysis was made of the

electroreflection spectra and the result of this analysis was a simple model of the electro-optic and optical properties of V_2O_5 below the fundamental absorption edge. According to this model, the electroreflection signal was not due to the influence of the electric field on the optical constants of V_2O_5, but was the consequence of the modulation of the carrier density at the surface of a sample. Hence, it was concluded that the optical properties of V_2O_5 were determined, in the investigated range of wavelengths, by the absorption of light involving carrier transitions. The resonant nature of the absorption and the electroreflection was attributed to the fine structure of the 3d conduction band of V_2O_5. (auth)

10609 NUCLEAR REACTOR FUEL ROD. Peehs, M. (to Siemens AG). German Patent 1,564,739. 12 Feb 1970. Filed date 13 Oct 1966. (In German).

It consists of pellets of uranium oxide (UO_2) filling the interior of a tube that constitutes an envelope of zirconium or an alloy of zirconium characterized by the fact that the pellets of UO_2 are provided, at least on the external periphery, with a layer of pyrographite of at least 1-micron thickness obtained by passage of gaseous methane at about 800°C over the pellets giving place to the separation of pyrolytic graphite. (TSS)

10610 CHARACTERIZATION OF REACTION PRODUCTS OF LIQUID SODIUM WITH CHROMIUM OXIDES. Yannopoulos, L. N. (Westinghouse Research Labs., Pittsburgh). J. Inorg. Nucl. Chem.; 36: No. 1, 214-218(Jan 1974).

Sodium chromite ($NaCrO_2$) is one of the important corrosion products of stainless steel encountered in the high-temperature (≥500°C) parts of sodium reactor loops. The ir spectra of several liquid-sodium preparations of sodium chromite were determined. The ir spectra were also determined for the products resulting from water treatment of some of these preparations and for vacuum-heated sodium chromite samples as well. A new preferred method is given for liquid sodium preparation of sodium chromite. Whenever possible and appropriate, the results of ir spectroscopy were supplemented by x-ray diffraction and chemical analysis of the samples. (UK)

10611 DISTRIBUTIONS OF ^{134}Cs AND ^{137}Cs IN THE AXIAL UO_2 BLANKETS OF IRRADIATED (U, Pu)O_2 FUEL PINS. Phillips, J. R.; Waterbury, G. R.; Vanderborgh, N. E. (Los Alamos Scientific Lab., NM). J. Inorg. Nucl. Chem.; 36: No. 1, 17-23 (Jan 1974).

The axial distributions of ^{134}Cs and ^{137}Cs in the axial blanket column of uranium–plutonium oxide fuel pins showed that the migration properties of the precursors of these two Cs isotopes were significantly different. The isotopic distributions were directly related to the half-lives of the two principal precursors of each cesium isotope, ^{133}I and ^{133}Xe for ^{134}Cs, and ^{137}I and ^{137}Xe for ^{137}Cs. Both cesium isotopes preferentially collected on natural UO_2 blanket pellets having high oxygen content. (auth)

10612 DISTRIBUTION OF FISSION PRODUCTS AMONG MOLTEN FUEL AND REACTOR PHASES. II. Distribution of Fission Products Between Molten Fe and a Molten UO_2–Basalt Mixture. Fischer, J.; Mrazek, F. C.; Chasanov, M. G. (Argonne National Lab., IL). J. Nucl. Mater.; 48: No. 3, 241-246 (Oct 1973).

The solubility of uranium dioxide in molten basalt was determined at 1550°C to be between 5 and 7 wt % and at 2200°C to be between 50 and 55 wt %. The distribution of some of the more important heat-producing fission products between molten iron and a molten UO_2–basalt mixture was studied. This was done to evaluate the use of basalt as a fuel diluent and sacrificial material in a fast breeder reactor and to predict the fission product heat distribution in such a system. It was found that La, Ce, and Nb were distributed to the molten UO_2–basalt mixture, and Mo and Ru were distributed to the molten-iron phase. (auth)

10613 DISTRIBUTION OF FISSION PRODUCTS AMONG MOLTEN FUEL AND REACTOR PHASES. I. Distribution of Fission Products Between Molten Fe and Molten UO_2. Fischer, J.; Schilb, J. D.; Chasanov, M. G. (Argonne National Lab., IL). J. Nucl. Mater.; 48: No. 3, 233-240(Oct 1973).

The distributions of some of the more important heat-producing fission products between molten Fe and molten UO_2 were studied; these experiments were carried out using an arc-melting furnace. It was found that Y, La, Sr, Ba, Zr, Pr, Ce and some Nb were distributed to the molten UO_2 and that Mo, Ru and some Nb were distributed to the molten iron phase. (auth)

10614 PREPARATION OF TRANSITION METAL BORIDES FROM THE AUXILIARY METAL BATH. Jangg, G.; Kieffer, R. (Technische Hochschule, Vienna). Monatsh. Chem.; 104: No. 1, 226-233(Jan 1973).

The "auxiliary metal bath process" for the preparation of hard materials and carbides, silicides, nitrides, and carbonitrides, is shown to be also suitable for preparing borides. Owing to the rather lower chemical stability of the borides compared with other hard materials, greater losses occur during dissolution of the auxiliary metals. Quantitative data concerning the stability of ZrB_2, TaB_2, and MoB_2 towards various aqueous media were obtained experimentally. Pure ZrB_2 and HfB_2 could be prepared from copper, lead, and tin melts; experimental results indicate that ZrB and HfB exist only when stabilized. Ternary phases containing auxiliary metals were not observed. (auth)

10615 NEW K BORIDES AND RELATED PHASES (FILLED UP Re_3B PHASES). Rogl, R. (Univ., Vienna); Nowotny, H.; Benesovsky, F. Monatsh. Chem.; 104: No. 1, 182-193(Jan 1973). (In German).

The crystal structure of the κ Hf–Mo–B phase was refined by means of Weissenberg photographs; the position 2a ($P6_3/mmc$) is occupied by Mo atoms, not B atoms. Thus, structural identity with Co_2Al_5 and Mn_3Al_{10} is obvious. The analogous K borides Zr_3Mo_4B (it forms complete solid solutions with Hf_3Mo_4B) and Zr_3W_4B also exist. Hf_3Mo_4B dissolves Al up to 14 at.% (1400°C). Further compounds with the above-mentioned structural type (K phases) were detected within the systems Zr–Mo–{Fe, Co, Ni} and Hf–Mo(W)–{Fe, Co, Ni}; the iron metal atoms occupy the boron positions. Phases with composition Zr_3 {Fe, Co, Ni} (N, O)$_x$, obtained by sintering, belong to the filled-up Re_3B-type structure. (auth)

10616 SUPERSTRUCTURE AND ORDER–DISORDER TRANSFORMATION OF INTERSTITIAL OXYGEN IN HAFNIUM. Hirabayashi, M.; Yamaguchi, S.; Arai, T. (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 35: No. 2, 473-481(Aug 1973).

Crystal structure and phase transitions in the hafnium–oxygen system containing 10 to 20 at.% O were studied by means of electron, neutron, and x-ray diffraction and calorimetry as well. The oxygen atoms occupy the octahedral holes in the hcp metal lattice and two types of interstitial superstructures are found at the hypo- and hyper-stoichiometric composition $HfO_{\frac{1}{3}-}$ and $HfO_{\frac{1}{3}+}$ below 430°C. The lattice constants of the hexagonal supercells are respectively $a = \sqrt{3}\,a_0$, $c = 3\,c_0$, and $a = \sqrt{3}\,a_0$, $c = 2\,c_0$, where $a_0 \sim 3.2$Å and $c_0 \sim 5.1$Å are those of the metal lattice. The oxygen sublattices are described in terms of the stacking sequence of interstitial layers parallel to the close-packed planes of the metal atoms. The concentration dependence of the ordered structures is interpreted in terms of strain ordering. (auth)

10617 CHANGES IN THE TEMPERATURE DEPENDENCE OF THE CONDUCTIVITY OF NONLINEAR SEMICONDUCTOR RESISTORS OF BLACK SILICON CARBON DUE TO REACTOR NEUTRON RADIATION. Ribarov, S. R. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 627-630(1973). (In Russian).

Before neutron irradiation of a varistor, the current showed an approximate linear dependence on the temperature. After irradiation, the current increase with increasing temperature was much more rapid than linear, probably because of annealing of defects. However, with decreasing temperature, the current dependence in the irradiated sample was still approximately linear. Obviously the neutron irradiation changes the properties of the monocrystalline silicon carbide granules in the varistor, but details of the processes causing the change in dependence have not been clarified. (auth)

10618 INVESTIGATION OF RELEASE OF TRITIUM IN HTR FUEL ELEMENTS. Walter, K. H.; Kienberger, K. H.; Lange, G. (Hochtemperatur-Reaktorbau GmbH, Juelich, Ger.). J. Nucl. Mater.; 48: No. 3, 287-292(Oct 1973). (In German).

In a nuclear reactor, tritium is produced by ternary fission and a number of further neutron-induced nuclear reactions. The liberation of the tritium so produced from the ceramic fuel of a high-temperature reactor was examined. Fuel particles with pyrocarbon coatings are able to retain tritium to a large extent under reactor operating conditions. The amounts of tritium found in reactor-irradiated fuel particles correspond within the limits of error with the calculated concentrations. The activation energy of the liberation factor for tritium from fuel particles is 106 kcal/mol in the temperature range 1400 to 1900°C. The release of the tritium found according to $^6Li\,(n,\alpha)^3H$ from a reactor graphite was measured and the concentration of tritium in graphite samples from the AVR nuclear power station was determined. (auth)

10619 NEUTRON ABSORBERS. Shepherd, L. R.; Hosegood, S. B. (to United Kingdom Atomic Energy Authority). US Patent 3,769,160. 30 Oct 1973. Priority date 21 May 1970, United Kingdom of Great Britain and Northern Ireland. 4p.

The use of nitrogen as a neutron absorber for a HTGR is applied by employing silicon nitride in a foamed or high-density

form. Materials having neutron absorption cross sections higher than silicon nitride may be incorporated with the silicon nitride. (9 claims, no drawings) (Official Gazette)

10620 OBTAINING POWDERS OF COMMERCIAL BORIDES OF TITANIUM, ZIRCONIUM, CHROMIUM, AND TUNGSTEN BY THE BORON-CARBIDE METHOD. Karasev, A. I. (Kiev Politechnical Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 1-5(Oct 1973). (In Russian).

The boron-carbide method is the most popular of all the known ways for obtaining borides of refractory metals. The dependence of chemical composition of titanium, zirconium, chromium diborides and the tungsten boride W_2B_5 on the following production technique parameters was investigated: temperature and exposure time, rate of temperature rise to the optimal level, and composition of gaseous medium in the furnace. The temperatures 1900 and 1800°C are established to be optimal, the former for TiB_2 and ZrB_2, the latter for CrB_2 and W_2B_5. The rate of temperature rise to the optimal one has no practical effect on the chemical composition. The exposure time depends on the loading weight and volume of the furnace reactive space. Converted gas can entirely replace hydrogen when obtaining the borides. Besides, the borides are possible to be obtained without a specially created gaseous medium in the furnace, i.e., in the carbon oxide medium, which is a gaseous product of the reaction. (auth)

10621 PHASE TRANSFORMATIONS IN BORON NITRIDE. Kurdyumov, A. V.; Pilyankevich, A. N.; Frantsevich, I. N. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 57-64(Oct 1973). (In Russian).

Crystal structure of various boron nitride modifications is considered. Experimental data are presented on phase transformations of boron nitride at high pressures and temperatures under conditions of both static pressures and shock waves. Pressure and temperature diagram for BN is analyzed and the mechanism of direct phase conversion of graphite-like structures to diamond-like ones is discussed. The authors' papers on the investigation of fine crystal structure of wortzite-like phase resulting from graphite-like BN under shock pressure are considered in detail. (41 references) (auth)

10622 X-RAY CHARACTERIZATION OF $Ce_2Zr_3O_{10}$. Longo, V.; Minichelli, D. J. Amer. Ceram. Soc.; 56: No. 11, 600 (Nov 1973).

The phase 2 $CeO_2 \cdot 3\ ZrO_2$, prepared by air-firing at <870°C, was studied by x-ray diffraction. The compound was indexed to tetragonal symmetry; the lattice parameters are $a = b = 5.267 \pm 0.003$ and $c = 6.034 \pm 0.003$ Å at room temperature. The space group is probably $P42_12$. The distribution of the atoms indicates internal disorder. (DLC)

10623 METHODS OF TESTING COATINGS ON COATED PARTICLE NUCLEAR FUEL. Lefevre, R. L. R. (to United Kingdom Atomic Energy Authority). British Patent 1,327,964. 22 Aug 1973. Filed date 12 Jan 1971. 2p.

In the method described a substance is incorporated in the kernel, or the coating layer adjacent to the kernel, a substance that on heating reacts with the fuel material or another substance in the kernel to evolve a gas. The coated particles are first weighed and then heated to a temperature which, in the event of any coating defect, will cause release of gas; any weight loss will indicate defective coatings. The kernel may include an oxide in intimate contact with C in the coating, so that heating results in the evolution of CO or CO_2. The coated kernels may form part of a compact containing a number of coated particles. (UK)

10624 CRYSTAL STRUCTURE OF TANTALUM(V) NITRIDE Ta_3N_5. Straehle, J. (Univ., Karlsruhe, Ger.). Z. Anorg. Allg. Chem.; 402: No. 1, 47-57(Nov 1973). (In German).

Single crystals of Ta_3N_5 are obtained by the reaction of $TaCl_5$ with NH_4Cl. Ta_3N_5 crystallizes in the orthorhombic space group Cmcm: $a = 3.893$, $b = 10.264$, $c = 10.264$ Å, $z = 4$. It is isostructural with anosovite (Ti_3O_5) and its structure is also closely related to that of Eu_3O_4Br. In the crystal structure the Ta atoms are surrounded by six N atoms in a distorted octahedral arrangement (Ta–N distances 1.96 to 2.26 Å). The TaN_6 octahedra are linked together by sharing edges and corners to form a three-dimensional framework. (auth)

10625 DEPOSITING A METAL LAYER ON A SUBSTRATE. Davis, G. L.; Charlton, M. G. (to Mullard Ltd.). British Patent 1,328,451. 30 Aug 1973. 3p.

The method described is stated to be particularly applicable in the manufacture of target electrodes for x-ray tubes, such electrodes comprising a W layer deposited on a refractory substrate. A solid metal oxide that shows enhanced volatility in the presence of water vapour is heated, and water vapour carried by an inert gas stream is passed over or through the heated oxide, the stream subsequently being mixed with a reducing gas in the neighbourhood of the heated substrate, resulting in the deposition of a layer of the metal on the substrate. The reducing gas is preferably H_2, and suitable metals are W, Re, Mo, etc. If the metal oxide is tungstic oxide it should be heated to 1200° to 1400°C, and the substrate heated to about 1200°C. The inert gas stream may comprise N_2. The rate of deposition is determined by the gas flow rate and the time the gas spends in the vicinity of the metal oxide. The substrate may comprise W, Mo, or W–No alloy. The metal oxide may be replaced by the solid metal, in which case the gas may carry an oxidising agent for the metal; if the metal is W the water vapour may constitute the oxidising agent. (UK)

10626 METHOD OF FABRICATING A CERAMIC MATERIAL. Meneret, J.; Allard, G.; Spite, B. (to Desmarquest (L.) et Compagnie). French Patent 2,133,017. 6 Apr 1971. 4p. (In French).

A process for fabricating a ceramic material is described. The process involves the forming of a powder consisting of a mixture containing at least one oxide and a carbide with an organic binder, a prebaking treatment in which the mixture is heated in an oxidising atmosphere to a temperature of between 550 and 580°C, and then a two-stage sintering procedure. The first stage consists of heating the mixture under vacuum to a temperature of between 850 and 950°C with a residual pressure of less than 0.1 torr, the second stage consisting of heating the mixture in an argon atmosphere from the upper temperature of the first stage up to a temperature of between 1550 and 1680°C. The mixture contains, at least, alumina and boron carbide. Such a material can be used as a fuel poison in nuclear reactors. (FR)

10627 EVOLUTION OF MICROSTRUCTURE DURING SINTERING OF UO_2 AND ITS EFFECT UPON MECHANICAL AND THERMAL PROPERTIES. Tuohig, W. D. Gainesville, FL; University of Florida (1972). 240p. University Microfilms Order No. 73-29,219.

Thesis (Ph. D.).

A full range of microstructural states, ranging from 50% to near theoretical density, were produced from UO_2 powders. Both conventional and pressure sintering (hot pressing) techniques were employed to fabricate the microstructures. Each state was characterized by its associated metric properties, i.e., volume fraction of void, area of void/solid interface, curvature, mean pore and mean grain intercepts, as determined by the procedures of quantitative metallography. Additionally, tensile strengths at room temperature and thermal conductivities over the intermediate temperature range were determined. The viewpoint was adopted that a sequence of states defined the path of microstructural change. It was found that sintering in the presence of an applied load (hot pressing) proceeds along a different path of microstructural development than does the same material under conventional sintering conditions. The evolution of microstructure during conventional sintering of UO_2 is shown to be qualitatively similar to that of metallic systems. The role of precompaction (cold pressing) upon the subsequent microstructural development is elucidated in terms of the area of pore/solid interface. Tensile strength and thermal conductivity were found to be functions of the initial particle size for densities below about 80% of theoretical. Inspection of fractured surfaces and microstructures indicates that these properties are sensitive to minimum cross-sectional areas in the porous solid network. Evidence is presented to show that this minimum area is in turn related to initial particle size. Properties of specimens greater than 80% dense showed little dependence on initial particle size. Increases in grain size are thought to be responsible for decreasing strengths found at very high densities. A marked decrease in thermal conductivity found for high-density specimens is attributed to the presence of a second phase, believed to be the result of contaminants in the starting material. (Diss. Abstr. Int., B)

10628 RARE-EARTH HYDRIDES AND RARE-EARTH OXIDES IN AND FROM THIN FILMS OF RARE-EARTH METALS. Gasgnier, M. (CNRS, Bellevue, France); Ghys, J.; Schiffmacher, G.; La Blanchetais, C. H.; Caro, P. E.; Boulesteix, C.; Loier, C.; Pardo, B. J. Less-Common Metals; 34: 131-142(1974).

Thin films of rare-earth metals always getter hydrogen very easily under ordinary conditions of preparation. It is shown from x-ray and electron diffraction experiments that the fcc hydrides appear as single-crystal inclusions especially in the case of the yttric series (except for ytterbium). The hydride inclusions yield conspicuous fcc diffraction patterns which should not be mistaken for a rare-earth monoxide, LnO, or for an fcc phase of the metal. Oxidation of the "metallic" thin films yields sesquioxide thin films. The electron diffraction pattern of C-type sesquioxides for large crystals in thin films exhibits "forbidden" diffraction spots

which apparently do not agree with the recognized T_h^5 space group. It is shown that these forbidden spots appear because of multiple diffraction effects. (14 figures, 34 references) (auth)

10629 LONG-PERIOD SUPERLATTICE IN DILUTE VANADIUM–OXYGEN ALLOYS. Gunwaldsen, D.; Potter, D. (Union Coll., Schenectady, NY). J. Less-Common Metals; 34: 97-106 (1974).

Alloys of vanadium containing up to 10 at.% oxygen were examined by transmission electron microscopy, selected-area electron diffraction, and x-ray diffraction. The presence of the V_9O phase was confirmed, and several electron-diffraction patterns of important reciprocal lattice planes of this phase were obtained. These patterns are explained using a long-period-superlattice $4 \times 4 \times 6$ vanadium atom cells in dimensions. It is further shown that the sites of this long-period superlattice correspond to tetrahedral positions for the interstitial atoms. The possibility of octahedral site occupation is discussed. (auth)

10630 STUDYING REDUCTION OF Nb_2O_5 WITH METHANE IN A FLUIDIZED BED. Pavlov, Yu. A.; Gal, V. V.; Nikitin, K. A.; Skachkova, T. M.; Kostenko, N. N. (Inst. of High Temperatures, Moscow). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 3, 8-10(1973). (In Russian).

The formation of niobium carbide during the reduction of niobium pentoxide in the pseudo-liquefied layer was studied. Intensive carbidization occurred at T > 1200°C, when the degree of decomposition of methane is close to unity. At 1400°C, niobium carbide containing 11.18% C is formed. (tr-auth)

10631 OXIDATION OF URANIUM DIOXIDE–YTTRIA SOLID SOLUTIONS. Ainscough, J. B.; Ferguson, I. F. (United Kingdom Atomic Energy Authority, Springfields). J. Inorg. Nucl. Chem.; 36: No. 1, 193-194(Jan 1974).

Yttria and uranium dioxide are mutually soluble over a wide range of compositions. The oxidation of $UO_2-Y_2O_3$ solid solutions has been studied by several workers and Bartram et al., (J. Am. Ceram. Soc.; 47:171 (1964)) have published a phase diagram of the $UO_2-UO_3-Y_2O_3$ system but with the phases in the oxygen-rich, yttrium-poor region at oxygen:uranium ratios greater than 2.667 not identified. In this note, results are reported on the oxidation of $UO_2-Y_2O_3$ solid solutions with yttria contents in the range 0 to 10 mole %. Analyses and weight gains in oxidized specimens are tabulated. X-ray powder photographs were taken of some of the oxidized materials and the lattice parameters are presented. (UK)

10632 SELF-DIFFUSION OF CARBON IN NbC. Kokon, H. (Osaka Univ.); Son, P.; Miyake, M.; Sano, T. Nippon Kinzoku Gakkai Kaiho; 37: No. 10, 1065-1068(Oct 1973). (In Japanese).

Self-diffusion coefficients of carbon in a carbide of niobium was measured in the temperature range 1800 to 2200°C, using radioactive tracer techniques. The self-diffusion coefficients can be expressed by $D^* = 0.86 \exp(-87{,}500/RT)$ (cm^2/sec). Comparing the present results with the chemical diffusivities obtained by the carbide layer growth method, it is shown that the relations between self-diffusivities and chemical diffusivities of carbon in the carbides of transition metals can be explained qualitatively on the assumption that carbon diffuses in the carbide by a vacancy mechanism. (auth)

10633 COMPOUND EuB_6 AS ABSORBER MATERIAL FOR FAST REACTORS. Schwetz, K.; Lipp, A. (Elektroschmelzwerk, Kempten, Ger.). Atomwirt., Atomtech.; 18: No. 11, 531-534(Nov 1973). (In German).

A survey of the production and properties of EuB_6 is given. EuB_6 can be obtained in a very pure form by the usual methods of powder metallurgy and has quite a number of good properties. Due to these material data and the higher reactivity compared to Eu_2O_3, EuB_6 could be used instead of Eu_2O_3 in fast reactors. (GE)

10634 STRUCTURE OF THE BERYLLIUM–BORON SYSTEM. Stecher, J.; Aldinger, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Z. Metallk.; 64: No. 10, 684-689(Oct 1973). (In German).

The constitution of cast or powder-metallurgically prepared beryllium–boron alloys containing up to 70 at. % B was studied in the solid and liquid states by thermoanalytic, microscopic, x-ray, and chemical techniques. Phase boundaries could be determined up to 1150°C. In the region studied, one eutectic, one metatectic, one eutectoid, and two peritectic invariant equilibria exist. In the region around 60 at. % B, a new phase with tetragonal symmetry and lattice parameters a = 7.25 A and c = 8.46 A was found. Because of about 1 wt % impurity in the specimens prepared by powder techniques and containing up to 50 at. % boron, a ternary phase formed which also had tetragonal symmetry and lattice constants of a = 10.22 A and c = 14.215 A. These values are close to the values for tetragonal boron, BeB_6, and AlB_{12}. (GE)

10635 MAGNETIC PHASE TRANSITIONS IN $GdVO_4$. Becher, W.; Kalbfleisch, H.; Melchior, K. (Univ., Karlsruhe, Ger.). Phys. Status Solidi (b); 60: No. 2, K113-K116(1 Dec 1973).

The phase diagram was obtained by ac susceptibility measurements. Results show that $T_N = 2.49 \pm 0.01$°K, and that $GdVO_4$ orders antiferromagnetically parallel to the c-axis. The magnetic phase diagram shows very good agreement between experiment and the critical field for renormalization calculated from spin-wave theory. H_{c1} (transition from antiferromagnetic phase to spin-flop phase) = 11 kOe; H_{c2} (renormalization) = 14 kOe. (DLC)

10636 INTERPRETATION OF AN ESR SPECTRUM OF γ-IRRADIATED SILICATE GLASSES. Ebert, I. (Zentralinstitut fuer Physikalische Chemie, Berlin). Phys. Status Solidi (b); 60: No. 2, K103-K104(1 Dec 1973).

The small differences between the g-tensors of centers in γ-irradiated silicate glasses and in other glasses are discussed. Another interpretation of the spectrum is offered, in which the resonance is attributed to adsorbed O_3^- ions. Thereby, a good agreement of g_3 with the valency of the cation (Si^{4+}, Ti^{4+}, or B^{3+}) is obtained. Hyperfine interactions are discussed. 12 references. (DLC)

10637 ELECTROPHYSICAL PROPERTIES OF INDIUM OXIDE PYROLYTIC FILMS WITH DISORDERED STRUCTURE. Korzo, V. F.; Chernyaev, V. N. (Moscow Aviation Tech. Inst.). Phys. Status Solidi (a); 20: No. 2, 695-705(16 Dec 1973).

An analysis is given of charge transfer in In_2O_3 thin layers, prepared by decomposition of indium acetylacetonate in an inert gas flow, as related to film structure (amorphous, ultra-disperse and polycrystalline) at weak and high fields. The temperature dependences of electric conductivity and Hall and drift mobilities were investigated in the temperature range from 77 to 465°K and in the frequency range from 10 to 10^7 Hz. The character of structural disordering is shown to influence the behavior of charge transfer in In_2O_3 thin films. Weak-field conduction mechanisms are characterized by internal potential barriers in the film structure and by specific features of the scattering by charged defects. (auth)

10638 VARIATION OF LUMINESCENCE INTENSITIES OF RARE-EARTH-DOPED LANTHANUM OXIDE POWDERS PREPARED AT VARIOUS TEMPERATURES. Ratinen, H. (Univ. of Oulu, Finland). Phys. Status Solidi (a); 20: No. 2, 521-526 (16 Dec 1973).

The optical fluorescences of eight trivalent lanthanide ions, Pr, Sm, Eu, Gd, Tb, Dy, Er, and Tm, in La_2O_3 were measured by x-ray excitation at 300°K. The doped powder samples were prepared at temperatures of ≈540, 640, and 750°C. The strongest intensities of lanthanides are tabulated. The fluorescence spectra of La_2O_3 doped with dysprosium as well as the background emission of pure La_2O_3 were also measured at 100°K. It was found that (a) the intensities of the peaks corresponding to the transitions from lower energy levels increase proportionally to the increase of the preparation temperature and (b) the intensities of the peaks corresponding to the transitions from higher energy levels increased most rapidly if the preparation temperature was raised from 540 to 640°C. (auth)

Metals and Alloys

Refer also to abstract 12474.

10639 (CEA-CONF-2226) METALLURGICAL DEVELOPMENTS AND APPLICATIONS OF ACTIVATION ANALYSIS. Darras, R.; Engelmann, C.; May, S. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 26p. (In French). (CONF-720704-3; SM-159/34). Dep. NTIS (U. S. Sales Only) $3.50.

From symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972).

After a review of a few generalities, methods of activation analysis used or under development at CEN-Saclay for application to studies of controls in metallurgy are described. Several examples are cited where this technique offers possibilities without rival, principally because of its specificity, simplicity, rapidity, and nondestructive character. Emphasis is placed on the fact that the judicious choice of the particle or radiation used (neutrons, protons, deuterons, helium 3 and 4, and γ photons) and of the operational conditions is essential in each particular case; often a judicious choice will simplify the analysis and the processing of data obtained from it. Gamma activation analysis makes it possible to realize inexpensive complete analyses on samples of relatively large size. Analysis by direct observation of nuclear reactions permits the determination of surface concentrations or concentration gradients with excellent sensitivity. (tr-auth)

10640 TESTING FOR PREDICTION OF MATERIAL PERFORMANCE IN STRUCTURES AND COMPONENTS. A Symposium Presented in Two Parts: Part I, Anaheim, California, April 21–23, 1971; Part II, Atlantic City, New Jersey, June 29–July 1, 1971. Philadelphia, PA; American Society for Testing and Materials (Oct 1972). 314p. (ASTM-STP-515; CONF-710470-P1; CONF-710667-P2). ASTM, Philadelphia $28.50.

From symposium on testing for prediction of material performance in structures and components; Anaheim, California, USA (21 Apr 1971).

Fifteen predictive testing papers are presented that contain theoretical considerations of empirical strength and examples of late developments in detection of flaws. Information is also included on achievement of reliability by use of a well designed testing program. The papers are not intended to be substitutes for the definitive textbook on the role of testing in the design process. A separate abstract was prepared for one paper. (JRD)

For an abstract of an individual paper see: 10746.

10641 PROGRESS IN FLAW GROWTH AND FRACTURE TOUGHNESS TESTING. Proceedings of the 1972 National Symposium on Fracture Mechanics, Philadelphia, Pennsylvania, August 28–30, 1972. ASTM Special Technical Publication 536. Philadelphia; American Society for Testing and Materials (1973). 401p. (ASTM-STP-536; CONF-720806-). $33.25.

Twenty-eight papers are included under the following section headings: theory and stress analysis, subcritical crack growth, temperature and environment, methods (J-integral), materials, and applications (fracture mechanics and pressure vessels). (DLC)

Corrosion and Erosion

Refer also to abstracts 9837, 9838, 9847, 9892, and 10588.

10642 (AAEC/E-270) CORROSION OF ALUMINIUM IN PURE WATER AND DILUTE SOLUTIONS. Berzins, A.; Evans, J. V.; Lowson, R. T. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1973. 40p. Dep. NTIS (U.S. Sales Only) $4.00.

An investigation into the corrosion of aluminium in flowing near-neutral water at 50°C is reported. The corrosion rate passed through a minimum as the pH was changed from pH 5.0 to 8.0. The pH at the point of minimum corrosion was sensitive to atmosphere, being highest in oxygen-saturated water. The corrosion rate was reduced and spallation of the oxide film prevented by saturating the water with oxygen. (10 tables, 7 figures) (auth)

10643 (AECL-4502) CORROSION BEHAVIOUR OF ZIRCONIUM AND ZIRCONIUM–CHROMIUM ALLOYS IN STEAM AT TEMPERATURES BETWEEN 325 AND 700°C. Ullrich, G.; Wiedemann, K. H. Translated from Z. Metallk.; 62: No. 12, 899-909 (1971). 17p. Dep. NTIS (U.S. Sales Only) $3.00.

It is well known that the corrosion of zirconium alloys follows initially a parabolic rate law and, after reaching a transition point, changes to a linear rate law. The phenomena of this breakaway are examined. Results in the system zirconium–chromium up to 2.5 wt% Cr in steam of 1 atm at temperatures between 325 and 700°C are discussed by means of a model proposed earlier. It is shown that the model proves to be useful, in understanding the "breakaway" phenomena. (auth)

10644 (CONF-720613-P2, pp 895-910) OUT-OF-PILE INVESTIGATIONS ON URANIUM DIOXIDE-FUELED TUNGSTEN-COATED MOLYBDENUM EMITTERS. Wahl, G.; Demny, J.; Batzies, P. (Brown, Boveri and Cie AG, Mannheim, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In the German In-core Thermionic Reactor (ITR) cylindrical molybdenum emitters are used. They are covered with two different CVD tungsten layers. Adhesion, diffusion, and work-function stability of the first layer, produced by the WF_6 technique, are described. Oxide evaporation and work function change by oxygen diffusion from the UO_x fuel to the surface were measured and could be correlated. To estimate the water-cycle corrosion, the oxidation probability (R_{ox}) of different materials were measured in H_2O atmospheres at 10^{-6} torr $< p < 10^{-5}$ torr and 1900°K: for polycrystalline Mo: $R_{ox} = (2.0 \pm 0.5)\%$, for polycrystalline W: $R_{ox} = (1.3 \pm 0.5)\%$, and for 110-oriented W: $R_{ox} = (0.3 \pm 0.05)\%$. According to the simplified model used, a hydrogen pressure of 4×10^{-5} torr is tolerable in the thermionic converter. (auth)

10645 (GKSS-73-E-10) INVESTIGATIONS ON STEAM GENERATOR TUBE SAMPLES OF INCONEL 600 AFTER LONG-TERM SERVICE IN THE FDR. Milferstaedt, D.; Schmelzer, F.; Schmitt, F. J. (Gesellschaft fuer Kernenergieverwertung, Hamburg (West Germany)). 1973. 24p. (In German). Dep. NTIS (U.S. Sales Only) $3.25.

Before the startup of the Otto Hahn Reactor, pipe samples of steam generator material were attached to the steam generator. These pipe samples were tested for corrosion behavior at given time intervals. After the first core change the samples were dismantled and investigated. From these investigations it was established that no damage or an anomalous corrosion behavior was detected. They are coated with a very thin blue–green solidly adhering oxide layer. A sharp decrease of the stability value was not established. (JSR)

10646 (IS-T-608) BONDING MODES OF SPECIES CHEMISORBED ON TUNGSTEN SINGLE CRYSTAL FACES. Anders, L. W. (Ames Lab., Iowa (USA)). Dec 1973. Contract W-7405-eng-82. 256p. Dep. NTIS $15.00.

Thesis

The relative bonding energies of hydrogen, nitrogen, and oxygen at three symmetric sites and W(100) surfaces were obtained by means of the Extended Hueckel Molecular Orbital Theory. The W(100) surface was represented by finite arrays of tungsten atoms (W_n). The energy change for the reaction $W_n + X \rightarrow W_nX$(X–H, N, O) was calculated for various assumed configurations of the W_nX "molecules". The preferred site for a hydrogen adatom was found to be the single coordination number (1 CN) site or the site above a surface tungsten atom. The nitrogen adatom preferred the five coordination number (5 CN site) or the four-fold site with a tungsten atom below and four tungsten atoms surrounding the nitrogen atom. The oxygen adatom preferred a two coordination number (2 CN) site or a two-fold, bridging site between two surface atoms. A model for the dissociative adsorption of CO on W(100, 110, 111) surfaces at room temperature was proposed based on flash desorption spectrometry results from mixed adsorption of $C^{16}O$ and $^{18}O_2$ on the above surfaces. The isotopic mixing of the oxygen in the desorbed CO molecules is indicative of dissociative adsorption. Results also contradicted the hypothesis that associatively adsorbed CO was converted to the dissociatively adsorbed C and O adatoms by the heating of the surfaces. The limiting ratios of $C^{16}O : CO_{total}$ desorbed from low and high coverages of preadsorbed $C^{16}O$ followed by saturated co-adsorbed $^{18}O_2$ coverages on the above tungsten surfaces enabled bonding models to be developed for the dissociated $C^{16}O$ co-adsorbed on the surface with associatively adsorbed $^{18}O_2$. (34 figures) (auth)

10647 (RD/B/M-2730) STUDIES ON MATERIALS IN THE VICINITY OF SODIUM–WATER REACTIONS. Part 3. The Influence of Sodium–Water Flames on the Fatigue Endurance of AISI 316 Stainless Steel. Marshall, P.; Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1973. 15p. (CFR/SMWP/P-(73)79; CFR/BMWP/P-(73)159). Dep. NTIS (U. S. Sales Only) $3.00.

Thin strips of heavily cold-worked and solution-treated AISI 316 stainless steel were exposed to sodium–water flames. Metallographic examination of specimens showed a brittle intergranular surface layer and electron probe work showed that this layer contained sodium and oxygen. The specimens were penetrated by this compound to a significant fraction of their cross section. Subsequent room-temperature fatigue endurance of the sodium/water exposed specimens was reduced by three orders of magnitude as a consequence of the brittle surface layer. Control samples heated in inert flames to similar temperature/time profiles were virtually unaffected compared with as-received materials. (auth)

10648 (RD/B/N-2683) AUGER ELECTRON SPECTROSCOPY OF MATERIALS EXPOSED TO FLOWING SODIUM. Hooper, A. J.; Wild, R. K. Part 1. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jun 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

As part of the programme of research to investigate the corrosion behavior of candidate materials for LMFBRs, the surface compositions of ferritic, nickel-rich, and stainless steel alloys exposed to flowing sodium were analysed by Auger Electron Spectroscopy (AES). A complementary examination of surface morphology was carried out using scanning electron microscopy. Mass transfer phenomena, particulate deposition, and corrosion product (sodium chromite) formation are discussed. Difficulties in interpreting Auger electron spectra of materials exposed to sodium are outlined and a preliminary assessment is made of the applicability of AES to sodium compatibility studies. (auth)

10649 (WAPD-TM-972) CORROSION OF LWBR ZIRCALOY END CAP WELDMENTS (LWBR DEVELOPMENT PROGRAM). Kass, S. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)).

Feb 1973. Contract AT-11-1-GEN-14. 83p. Dep. NTIS $6.25.

Rapidly cooled TIG weldments on Zircaloy, such as those made during the joining of thin-walled tubing to solid end plugs, exhibit unique corrosion resistance in high-temperature steam. In general, the weld area has excellent corrosion properties except for a thin line around the circumference which usually exhibits accelerated corrosion. The corrosion performance and metallurgical structure of some local parts of the weld area are markedly similar to those obtained with rapidly cooled electron-beam welds. Corrosion tests have shown that very rapidly cooled EB weldments, i.e., cooled faster than 750°F/s through the alpha plus beta to alpha transformation temperature, corrode excessively in high-temperature steam. All noncontaminated weldments corrode at "normal" rates in hot water at temperatures of 680°F and below. Extended time corrosion tests with TIG welds on Zircaloy-4 tubing in 680°F water also yield adherent, normally growing oxides; the TIG-weld corrosion rate is similar to that of the base metal. Chemical composition of these EB welds that exhibit accelerated corrosion when exposed to high-temperature steam and of those that do not are markedly similar although depletion of the alloying elements is brought about by the EB welding process. Tests with binary zirconium–tin alloys confirmed the above conclusion and further confirmed the observations that the absence of intermetallic compound precipitation leads to accelerated corrosion in high-temperature steam. Very rapid cooling of some types of weldments precludes the precipitation of the second-phase particles which are needed to maintain good steam corrosion resistance. Hydrogen pickup of fast-cooled weldments during corrosion in hot water is judged to be no different from that of Zircaloy-4. It was also found that the methods of corrosion-test procedure in performing the steam test do not influence the corrosion characteristics of corrosion-prone weldments. Prefilming TIG or EB weldments in hot water prior to exposure to steam delays the onset of, but does not eliminate, the accelerated corrosion. The behavior of weldments in high-temperature steam is different from that in hot water. Visual examination of irradiation test rods containing TIG-welded Zircaloy end caps exposed at 600°F in pH 10 ammonia coolant have failed to reveal any instances of accelerated corrosion. The behavior in the irradiation environment confirms the conclusion that the corrosion of fast-cooled weldments in high-temperature steam does not reflect the behavior in water. (auth)

10650 STUDIES OF THE OXIDATION OF RHENIUM POWDER. Martens, H.; Ziegenbalg, S. (Forschungsinstitut fuer NE-Metalle, Freiberg, Ger.). Z. Anorg. Allg. Chem.; 401: No. 2, 145-157(Oct 1973). (In German).

The oxidation of Re powder was investigated at 360 to 640°C in an air stream. The final product of the oxidation is Re_2O_7. In an intermediate stage, the Re powder is completely converted to ReO_2 and ReO_3. The kinetics of oxidation of ReO_2–ReO_3 mixtures to ReO_7 was measured thermogravimetrically. The rate of oxidation is decreased by the presence of impurities (Tl, Sb_2O_3, Al_2O_3) in Re. The vapor pressure of Re_2O_7 at 200 to 325°C corresponds to the following expression: $\lg p_{Re_2O_7} = -6416.9\ T^{-1} + 13.02$ (torr). (auth)

10651 INVESTIGATIONS INTO THE CORROSION BEHAVIOR OF ZIRCONIUM ALLOYS. III. Investigations of Zirconium–Titanium Alloys. Jangg, G.; Kieffer, R.; Watti, A. (Technische Hochschule, Vienna). Werkst. Korros.; 24: No. 16, 845-850 (Oct 1973). (In German).

Investigations on zirconium alloys containing up to 40% titanium and, eventually, up to 10% Nb or Mo and small amounts of Fe, Ni, and Cr (together 1.5% maximum) have revealed that titanium increases the solvent power of zirconium for other alloying elements without tending to form two-phase structures. As to corrosion behavior, the better alloys are somewhat superior to other alloys. While titanium impairs the corrosion resistance of pure zirconium with respect to boiling mineral acids (20% HCl, sulfuric, or nitric acids), titanium additions up to 10% improve the corrosion behavior of ZrNb and ZrMo alloys; alloys of the type Zr10Nb10Ti or Zr10Ti10Ta are comparable, with respect to the corrosion resistance, to pure zirconium. The scaling resistance of zirconium passes through a minimum at a five to ten percent Ti and arrives at its maximum value with 40% Ti. Further improvements may be obtained by addition of 10% Nb. (GE)

10652 CORROSION-RESISTANT Zr ALLOY. Givord, J. P.; Demars, H. (to Ugine-Kuhlmann). French Patent 2,129,158. 17 Mar 1971. 8p. (In French).

A zirconium base alloy containing 0.5 to 1.5% iron and vanadium is presented, a special characteristic of the alloy being its vanadium contents which lie between 0.05 and 0.10% (by weight). This alloy can be used in the structural elements, pressure tubes, calander tubes, channel tubes and fuel element cladding tubes of the cores of nuclear reactors cooled by water, steam–water mixtures, or superheated steam. (FR)

10653 STRESS-CORROSION CRACKING OF SENSITIZED STAINLESS STEEL IN OXYGENATED HIGH-TEMPERATURE WATER. Berry, W. E.; White, E. L.; Boyd, W. K. (Battelle Columbus Labs., Columbus, OH). Corrosion; 29: No. 12, 451-469(Dec 1973).

The stress corrosion cracking (SCC) behavior of sensitized Type 304 stainless steel was studied in 288°C primary water as a function of oxygen and fluoride contents of the water, stress level, prestrain, heat treatment, and surface preparation (tarnish film, surface ground, or pickled). Susceptibility to intergranular cracking increased with increasing oxygen content in the water, increasing stress levels, or with tarnished or pickled surfaces. The other variables had little or no effect. Sensitized wrought Types 309 and 316 stainless steels were also susceptible to intergranular SCC, while sensitized Types 304L, 308L, and 347 stainless steels and Incoloy Alloy 800 and Inconel Alloy 600 did not crack under the most severe test conditions (3Sm stress loading in 288°C water containing 100 ppM oxygen). (14 tables, 14 figures) (auth)

10654 MAGNETIC HYSTERESIS IN $SmCo_5$ INTERMETALLIC COMPOUNDS. Kraposhin, V. S.; Linetskii, Ya. L. (Inst. of Steel and Steel Alloys, Moscow). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 3, 128-129(1973). (In Russian).

For powdered $SmCo_5$ samples, curves of demagnetization, growth, and specific remanent magnetization vs the demagnetization field after destruction at different time intervals and after corrosion were determined. The value of the magnetization and the shape of the curves of the dependence of the remanent magnetization on the demagnetization field depended on the time the sample was held in the constant demagnetization field. The relative change in magnetization in a given field and the magnetization relaxation time were determined by the structural state of the powder. (tr-auth)

Preparation and Fabrication

Refer also to abstracts 11825–11833, 12127–12132, 12168, and 12436.

10655 (CONF-720613-P2, pp 623-644) VAPOR DEPOSITION OF REFRACTORY METALS APPLIED TO THERMOELECTRONIC CONVERSION. Performances of Deposits Obtained by Fluoride Reduction at High Temperature and Low Pressure. Faron, R. (Societe des Usines Chimiques, Pierrelatte, France); Barques, M.; Gilliardeau, J.; Hasson, R.; Dejachy, G.; Durand, J. P. 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

For the development of thermoelectronic emitters, the growth of refractory metal deposits by reduction of the metal fluorides at high temperature and low pressure is described. It was possible to obtain vapor deposits of high quality, with epitaxy on the metallic substrate, very pure, adherent, and compact. A procedure to cause the surface appearance of high-density crystallographic planes is described. The results of the examinations of these crystalline growths by metallography, scanning microscopy, Castaing microprobe, and radiocrystallography are described. The particular technology necessary for the reduction of the gaseous metallic fluorides at high temperature and low pressure is described. (tr-auth)

10656 (CONF-720613-P2, pp 645-654) VAPOR DEPOSITION OF HIGH WORK FUNCTION MATERIALS IN A GAS DISCHARGE. Venker, H. (EURATOM-CCR, Ispra, Italy). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A technique was developed that influences the crystal orientation of vapor-deposited materials in order to obtain high work-function surfaces. The process makes use of a glow discharge between the substrate to be plated (cathode) and the reaction chamber during deposition. The substrate to be plated is heated by cathodic ion bombardment to the temperature necessary for reducing a refractory metal halide with hydrogen (about 1000°C). The crystal growth is influenced by bombardment in such a manner that a smooth surface is obtained, with crystallographic planes of highest atom density parallel to the surface (110-planes in case of bodycentered cubic metals). The mechanism of crystallization under these conditions and the influence of chlorine and bromine additions on the mixture of reaction gases are discussed. For thermionic application molybdenum cylinders of plain and cylindrical geometry have been plated with 110-oriented W. Work functions up to 4.95 eV were obtained using WF_6 as starting material. The uniformity of the crystallographic orientation was determined by x-ray diffraction methods. (auth)

10657 (CONF-720613-P2, pp 655-666) IMPROVEMENT OF CHEMICAL VAPOR DEPOSITION OF TUNGSTEN AND MOLYBDENUM FOR THERMIONIC CONVERSION. Shroff, A. M.; Letourneux, P.; Delval, G. (Thomson-CSF-GTE, Orsay, France). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Experimental results are presented showing that, for the tungsten hexafluoride reduction, reliable and low-cost coating can be obtained for emitters when long term life in the diode is necessary. WF_6 gives [100] direction which is sufficient for any application. In the case of thermionic converters [110] crystal orientation for W seems very interesting; this can be achieved either by using chlorides or by adding electronegative gases to the hexafluoride–hydrogen mixture during deposition. Results obtained confirm that both technics are competitive. A better understanding of the deposition procedure and the crystal growth by the study of the early stage of the deposition supports the conclusion that the rate of growth is different according to the crystal orientation. (auth)

10658 (CONF-720613-P2, pp 667-679) STUDIES OF THE INFLUENCE OF CVD TUNGSTEN DEPOSITING CONDITIONS ON THE FORMULATION OF PORES RESULTING FROM INTERDIFFUSION IN THE EMITTERS OF THERMIONIC CONVERTERS. Roux, F.; Ablitzer, D.; Vignes, A. (Ecole Nationale Superieure, Nancy). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The appearance of "Kirkendall" pores and the diffusion of molybdenum in tungsten grain boundaries was studied using molybdenum–tungsten diffusion compounds produced by tungsten deposited on molybdenum in the vapor phase. The tungsten deposits were obtained through the reduction of WF_6 by H_2 under various experimental conditions (temperature, partial pressure of the halide, and total pressure in the reactor). For the tungsten–molybdenum configuration, it is possible to counteract the occurrence of pores during the subsequent state by an appropriate electrolytic reaction on the substrate under deposition conditions, where the tungsten supersaturation is relatively high, and by a deposition method in which the increase of tungsten is effected "epitaxially" with the substrate. As a consequence of the method of epitaxial growth, the tungsten deposition involves a minimum number of grain boundaries. Porosity can be eliminated and intergranular diffusion reduced by annealing. By carrying out the deposition in this manner, it is possible to obtain emitters that retain their thermoelectric emission properties during service periods of more than 10 operating hours. (JRD)

10659 (CONF-720613-P2, pp 845-859) 110-ORIENTED CVD TUNGSTEN LAYERS. Batzies, P.; Schroeder-Babo, P.; Wahl, G. (Brown, Boveri and Cie AG, Mannheim, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The influence of deposition geometry on the crystal orientation of the deposited layer was investigated for the tungsten chloride–hydrogen system. On plane samples, areas of pure 111- and 110-orientation were found simultaneously. On cylindrical samples, the 110-orientation alone could be deposited. These surfaces were shown to have high electron work functions. A correlation between reduced x-ray-diagram intensities and measured work functions for plane samples was established. It allows the prediction of the work functions directly from the diagrams. (auth)

10660 (CONF-720613-P3, pp 1445-1453) PRODUCTION OF HIGH-PURITY BARIUM AND CESIUM BY CHEMICAL REACTION FOR APPLICATION IN THERMIONIC CONVERTERS. von Bradke, M.; Mahr, D.; Pfeiffer, R. (Institut fuer Energiewandlung und Elektrische Antriebe, Stuttgart). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A survey of the possibilities to introduce high-purity alkali and alkaline-earth-metals into a ultra-high vacuum system is presented. This is of interest for the vapor supply of experimental thermionic converters or similar research devices. The desired metals are produced inside the vacuum system by chemical reactions originating from compounds of a lower chemical activity. This is a very simple and reliable way to introduce substances of high chemical activity into a demountable ultrahigh vacuum system. Considerations about the economy of this process give further motivation to prefer it over the use of pure metal in ampules. A chemical method of barium production suitable for use in ultrahigh vacuum systems is described. Best results were obtained by the reaction: $3\ BaO + Ti \rightarrow 2\ Ba + BaTiO_3$ at a reaction temperature of about 1000°C. Continuous maintenance of the reaction requires a state of nonequilibrium, i.e., the barium originated has to evaporate immediately out of the reaction mixture. For a good efficiency and a high purity of the product, careful preparation and handling of the original compounds is required. For the production of cesium, a well-known procedure is used. The original compounds are cesium chromate and silicon. The main problem for the application is the exothermic character of this reaction. Therefore, it is difficult to control the velocity of reaction if quantities of several grams are to be introduced. Many preliminary tests were necessary to find out the best parameters for a continuous controllable reaction, such as the weight ratio of the original compounds and the mixing process. Investigations about the efficiency of reaction and the purity of the product depending on reaction temperature and reaction time were carried out. The practical application of the experimental apparatus and experiences in using these methods are reported. (auth)

10661 (COO-3466-9) RESEARCH IN POWDER METALLURGY. Final Report. Lenel, F. V. (Rensselaer Polytechnic Inst., Troy, N.Y. (USA)). Aug 1973. Contract AT(11-1)-3466. 15p. Dep. NTIS $3.00.

Results of research on the mechanisms of sintering are summarized. Work in the project was directed primarily to studies of material transport during the early stages of sintering in single-phase materials such as pure metals and ionic solids. Efforts were made to show that the growth of contact between particles during sintering is directly associated with the generation and motion of dislocations. It is noted that quantitative relations for rates of sintering were not established in the project. Directions for future sintering research are suggested. (JRD)

10662 (HEDL-SA-664) CONSIDERATION ON LIMITS OF COLD WORKING IN NUCLEAR CONSTRUCTION. Moen, R. A.; Smith, G. V. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. Contract AT(45-1)-2170. 32p. Dep. NTIS $3.75.

The effects of cold working on reactor metals were investigated. It is concluded that the mechanical properties of austenitic stainless steels are affected to varying extents by cold working during fabrication processes. The current ASME Code position appears to be one of recognizing the importance of the cold-working effects; however, the responsibility to account for the effects is now left with the designer/manufacturer. In the manufacture of metallic nuclear components for elevated-temperature service, every effort is made to avoid cold working. Where cold working cannot be avoided, designers are making conservative adjustments in allowable stresses and strain limits, utilizing the body of data summarized. Several concerns are mentioned regarding the use of cold-worked material in Coded applications. Some of the possible methods by which designers might address cold work effects are discussed. It is hoped that generalized treatments of cold work effects can be formulated, agreed upon, and standardized via the Code. (auth)

10663 (RDT-M-3-1-C-T(11-73)) CARBON AND ALLOY STEEL PIPE (ASME SA-333 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D.C.). Nov 1973. 8p. RSO.

A standard prescribing requirements for carbon and alloy steel pipe (ASME SA-333 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDTM3-16T, dated January 1972. (JRD)

10664 (TID-26496) LOADING OF PARTICULATE FUELS INTO COMPLEX SHAPES. Jandrisevits, R. A.; Fraser, H. R.; Richardson, M. H. (Argonne National Lab., Ill. (USA)). 3 Sep 1965. 15p. Dep. NTIS $3.00.

A shell and tube configuration was packed with spherical steel shot by vibratory compaction. A secondary mode of vibration was found necessary to attain a limiting packing efficiency of 0.635. An equivalent diameter of the configuration was proposed and, in terms of this and the particle diameter, the packing efficiency was found to be: $Pe = 0.635 - 0.350\ e^{-0.451D/d}$. (auth)

10665 QUALITY OF GADOLINIUM SINGLE CRYSTALS GROWN DURING SOLID-STATE ELECTROLYSIS. Jordan, R. G.; Jones, D. W.; Mattocks, P. G. (Univ., Birmingham, Eng.). J. Less-Common Metals; 34: 25-29(1974).

Gadolinium single crystals grown during solid-state electrolysis are assessed in terms of chemical purity and crystallinity. Crystals of chemical purity >99.9% atomic, resistance ratio ~250, and mosaic spread ~1 min of arc were grown. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 11325, 11817, 11868, 11869, 12449–12453, 12455, 12459, 12462, 12469, 12475, 12485, and 12488.

10666 (BMI-X-629) CHARACTERISTICS OF COMMERCIAL VACUUM-HOT-PRESSED BERYLLIUM. Summary Report. Gelles, S. H.; Peterson, J. H. (Battelle Columbus Labs., Ohio (USA)). 1970. Contract W-7405-eng-92. 109p. Dep. NTIS $7.50.

The tensile properties of four grades of well-characterized commercial hot-pressed beryllium block were determined at room temperature to 1100°F and supplemented with measurements of the strain-rate dependence of one of the materials at 500 to 1100°F at strain rates of 0.0385 to 5 per min. The four hot pressings studied were, in general, found to be quite uniform in structural, chemical, and mechanical properties, although significant differences in uniformity among the four were found. All hot-pressed blocks were found to have densities below theoretical. An initial yield point was found in three of the four materials; it was absent in the metal with the largest grain size. No influence of chemistry on the occurrence of a yield drop was found within the compositional range investigated. The magnitude of the yield drop generally increased with temperature, reaching a maximum at 400 to 700°F, and disappeared between 900 and 1100°F. It was found to be insensitive to changes in strain rate between 0.0385 and 5 per min. The yield point could be removed by pressurization or heat treatment and made to reappear by heat treatment. Small amounts of preferred orientation were found to have a marked effect on the mechanical behavior at room temperature to 500°F. The ductility is especially influenced and leads to a ductile–brittle transition temperature which differs by approximately 100°F in the pressing and transverse directions. Serrated yielding (Portevin–Le Chatelier effect) was found in three of the materials at 900°F and a strain rate 0.0385 per min. It was also present at 1100°F and 0.5 per min in the one material tested at increased strain rates. Yield and ultimate tensile strengths were found to be relatively insensitive to strain-rate variations over the range from 0.0385 to 5 per min. The ductilities, however, were greatly decreased by an increase in strain rate and the behavior could be interpreted in terms of a shift in the ductile–brittle transition temperature of 150 to 200°F. Results of metallographic observation on sections of fractured tensile samples indicated that ultimate failure was caused by the joining of stable cleavage cracks at room temperature, by ductile rupture at 700°F, and by intergranular failure caused by void coalescence at 1100°F. An increase in yield strength at 300 to 500°F compared with that at room temperature was found in one of the materials; this is interpreted as evidence of strain aging. This phenomenon has been related to the iron/aluminum ratio and the amount of iron in solid solution. It is concluded that embrittlement could arise from a combination of strain aging, a high initial yield point, excessive preferred orientation, and increased work-hardening rates due to high strain rates. (auth)

10667 (CEA-CONF-2423) STUDY OF CREEP DEFORMATIONS UNDER COMPLEX APPLICATIONS IN AN AUSTENITIC STAINLESS STEEL. Creep Under Progressive Load at High Temperature. Calvet, J. N.; Le Bret, P.; Petrequin, P.; Duret, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). [nd]. 37p. (In French). (CONF-730726-9). Dep. NTIS (U.S. Sales Only) $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Jackets of fuel elements are exposed during their time in the reactor to different stresses, particularly to the pressure of fission gases whose value increases as a function of time, and to stresses of thermal origin provoked by the temperature gradient in the jacket thickness. Tests were made as near as possible to the actual stress conditions and the results were analyzed beginning with tests made under constant stress and temperature. On a Z6 CND 18-12 (316) steel in the hypertempered state, tests were made under variable load, $P = Kt$ ($\sigma = Kt$) at a temperature of 700°C. The values of K vary from 0.7×10^{-3} to 40×10^{-3} kg/mm²/h, and the maximum deformations reached are of the order of 1%. The analysis of the results leads to an empirical method for determination of deformations under progressive load. The results obtained at 700°C on a steel of the same type are compared with the curves calculated beginning with constant-stress tests by integration, following the hypotheses of time hardening and strain hardening of a $\epsilon = f(\sigma,t)$ law representative of primary creep. It was shown that the strain-hardening hypothesis is the most representative of the deformation mechanism. An approximate method, using average rates to attain a given deformation, is presented. (tr-auth)

10668 (CONF-720540-(Absts.)) SYMPOSIUM ON FRACTURE AND FATIGUE, MAY 3–5, 1972. Preprinted Abstracts of Symposium Papers. (George Washington Univ., Washington, D.C. (USA). School of Engineering and Applied Science). 1972. 94p.

From symposium on fracture and fatigue; Washington, District of Columbia, USA (3 May 1972).

Abstracts of 80 papers scheduled for presentation at the symposium are compiled. The abstracts are divided into sessions on fracture mechanics, concepts of fatigue, nondestructive testing, engineering applications, fracture control, and general survey of material behavior. (JRD)

10669 (CONF-720613-P2, pp 725-736) ROOM-TEMPERATURE DUCTILITY OF DIFFERENT TYPES OF MOLYBDENUM AFTER DIFFERING ANNEALING. Robert, G.; Sainfort, G. (CEN, Grenoble, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

After irradiation at 1650°C, the molybdenum can for thermoelectronic emitters, shows a marked increase in grain size and sometimes intergranular cracking. This intergranular embrittlement is dependent on grain size but must equally be linked to the presence of impurities and precipitates in the grain boundary, which can also limit the size of grains. The increase in grain size for different types of molybdenum annealed at high temperatures was studied. The samples were manufactured by melting or sintering. A study was made of grain boundary precipitates, of samples fractured at –196°C, by the use of electron scanning. The molybdenum samples manufactured by melting were found to have a greater tendency for increasing grain size than the sintered molybdenum. This is due to the presence of fine refractory particles in the sintered product. The mechanical properties after annealing were studied by testing at room temperature. It can be seen from the results obtained that there is a greater fragility in all cases, except for the sample made by sintering and containing a fine dispersion of ZrO_2 particles. (auth)

10670 (CONF-720613-P2, pp 737-745) CREEP AT HIGH TEMPERATURE AND UNDER STRONG STRESSES OF DIFFERENT GRADATIONS OF MOLYBDENUM. Gregoire, J.; Sainfort, G. (CEN, Grenoble, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The lifetime of fuel elements for thermoelectronic converters depends on numerous parameters and particularly on the resistance to creep of the fuel jacket. In effect, under the influence of the fission gas and of an eventual swelling of the fuel (UO_2 or UO_2 – Mo cermet) the jacket can be subjected to stresses capable of causing creep deformation and thereby, a decrease of the interelectrode space. The French projects of thermoelectronic converters envisage a Mo jacket. A characterization of the resistance to compression creep under strong stresses of different gradations of Mo is presented. These gradations are differentiated either by their mode of preparation (fritting or arc fusion) or by their composition (pure and with addition). The creep tests were made under vacuum between 1500 and 1800°C and the creep rates were measured in the region from 5×10^{-4} to 10^{-3} min^{-1}. Generally the gradations prepared by fritting have a better resistance to creep than the gradations prepared by arc fusion. Moreover for each method of preparation (fritting or fusion) the efficiency of the hardening elements (addition of Ti, Zr, or particularly ZrO_2) appears very clearly. This improvement of the creep resistance by use of fritted products or products containing specific additions is more marked when the creep temperature is low. (tr-auth)

10671 (CONF-720613-P2, pp 797-818) STUDIES OF PHYSICAL–MECHANICAL PROPERTIES OF MOLYBDENUM AND TUNGSTEN MONOCRYSTALS AND ELECTRICAL CHARACTERISTICS OF TIC (THERMIONIC CONVERTER). Kuznetsov, V. A.; Zasorin, I. P.; Belomyttsev, Yu. S. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Monocrystals of molybdenum and tungsten used as an emitter of thermionic converters have some advantages in comparison with polycrystal materials. Investigations of physical–mechanical properties, structures, and thermionic characteristics of monocrystals of molybdenum and tungsten with different crystallographic orientations and purity were carried out showing their possibilities. Such thermionic properties as work function, s-shape, and volt–ampere characteristics and specific electrical capacity of monocrystals of molybdenum at 1400 to 1600°C in experiments with plane geometry at different residual pressures were studied. With the help of high temperature optical and electron and field-emission microscopes the processes of oxidation of Mo-monocrystals were investigated. It was found that at pressures of 1×10^{-4} torr and higher at temperatures 1200 to 1700°C oxides, consisting of MoO_2, MoO_3, Mo_9O_{26}, etc, appeared on the surface. The oxidation process is reduced by introduction of cesium vapor into the volume. Mechanical properties of molybdenum and tungsten

monocrystals in the temperature range of 20 to 1600°C were defined. Satisfactory structure stability of the material at temperatures of 1400 to 1600°C under the thermionic-converter operating conditions was found. By the autoradiography method with the use of radioactive isotope ^{14}C the carbon distribution in molybdenum monocrystals of different purity was investigated. The compatibility of the metal with uranium dioxide at temperatures up to 1600°C was studied. (auth)

10672 (CONF-720613-P2, pp 989-1000) OUT-PILE CYCLING WITH EMITTERS. Peehs, M.; Schoerner, H. (Siemens AG, Erlangen, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

During the development of emitter fuel systems it has been shown that the thermal stresses that result from load cycling are of considerable importance. In order to simulate the action of the fuel as a heat source, and to reproduce the temperature distribution which occurs during operation, systems with electron beam heaters were built. The required energy supply can be controlled automatically. In this way predetermined test programs can be carried out independently. A test program concentrating on the revolver-type emitter was carried out for up to 300 load cycles, using molybdenum emitters both with and without tungsten layers. The emitters were measured both during and after the test period, and it was found that they contracted during load cycles. In addition a waviness was noted on the surface, the number of waves corresponding exactly to the number of fuel chambers. (auth)

10673 (CONF-720613-P3, pp 1301-1321) WORK FUNCTION OF BARE AND COATED METAL SURFACES. Wagner, H. (Kernforschungsanlage, Juelich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A survey of approaches to work-function calculations is presented. It is noted that the newer theoretical approaches of work-function changes due to alkali adsorption yield further insight into the underlying physical phenomena involved and are able to derive from first principles a description of the experimental results. For thermionic applications, however, the semi-empirical theories with an appropriate choice of adjustable parameters yield, for the time being, a better description of the experimental findings and provide more useful engineering data. (auth)

10674 (CONF-720613-P3, pp 1323-1338) THERMODYNAMIC ANALYSIS OF METAL SURFACES COVERED BY ELECTROPOSITIVE ADSORBATES. Gyftopoulos, E. P. (Massachusetts Inst. of Tech., Cambridge); Hatsopoulos, G. N. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The analysis applies to surfaces for which the work function of the substrate surface is larger than the electronegativity of the free atoms of the adsorbate. The thermodynamic potentials and random fluxes associated with a surface in mutual stable equilibrium with the adsorbate vapor are computed. These results are then adapted to the problem of evaluation of the emission characteristics of the surface in a steady state. It is concluded that no satisfactory general theory for electropositive surfaces exists in the degree of coverage range greater than 0.5 of theoretical. (JRD)

10675 (CONF-720613-P3, pp 1339-1350) WORK FUNCTION THEORY FOR Cs-[W] AND Cs-O-[W]. Warner, C. (Atomics International, Canoga Park, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Work function theory is developed in two areas of importance to thermionics: first, the high cesium coverage collector-type regime where most theoretical work is inconsistent with the metallic character of the cesium surface layer; and second, the emitter-type regime in the presence of oxygen additives. The first collector-type regime for Cs-[W] is treated by the Hohenberg-Kohn theory for an inhomogeneous electron gas. A digital computer was used to solve the Euler-Lagrange equation in the slowly varying density approximation for the electron density. Knowledge of the electron density implies the electrostatic potential, the exchange-correlation potential, and finally the work function. The Cs-[W] solutions exhibit a work function minimum with increasing coverage. The work function minimum and associated electron density is discussed in terms of the polarization of an equivalent cesium film interaction with the tungsten substrate. The second emitter-type regime is studied with a statistical mechanical model which predicts departure rates as a function of cesium and oxygen coverage. After formation of a WO surface, cesium adsorption decreases the composite work function. This adsorbed cesium acts as a site for additional oxygen adsorption. The electric dipole moment of the CsO is assumed to vanish. The work function then increases with the resulting oxygen adsorption. The results are in semi-quantitative agreement with the data of Alleau and Bacal. (auth)

10676 (CONF-720613-P3, pp 1351-1360) WORK FUNCTIONS, THERMAL STABILITY, AND ATOMIC STRUCTURE OF ELECTROPOSITIVE FILMS ADSORBED ON METALLIC MONOCRYSTALS. Vedula, Yu. S.; Konoplev, Yu. M.; Medvedev, V. K.; Naumovets, A. G.; Smereka, T. P.; Fedorus, A. G. (Inst. of Physics, Kiev). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The work functions of a series of faces of single-crystal W, Mo, and Nb covered with Cs, Na, Li, or Ba were studied. It was found that the atomic structure of the adsorbent influences the dependences of the work function and the heat of adsorption on the surface concentration of the adatoms. An exact correspondence was found between structural variations of adsorbed films at coverage variations and concentrational dependences of the work function and the heat of adsorption. (JRD)

10677 (CONF-720613-P3, pp 1361-1374) PLASMA IMMERSION PROBE MEASUREMENTS OF ELECTRON WORK FUNCTION. Herion, J.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

An improved plasma immersion probe device for measuring work functions in a gas atmosphere is described which avoids some problems encountered with the plasma immersion probe technique. These include the problem of measuring the probe temperature especially at low temperatures, the nonuniform temperature profile along the probe wires, the potential drop over the probe due to the heating current, and the overall temperature drop due to electron emission cooling or switching off the heating current. The device was tested with a W and a Re probe in a Cs atmosphere. The work function of an Os-coated W probe in Cs was determined as function of the probe temperature. A work-function minimum of 1.64 eV was obtained at a ratio of probe temperature over Cs bath temperature of 2.2. (auth)

10678 (CONF-720613-P3, pp 1375-1384) WORK FUNCTION DEPENDENCE ON CRYSTAL ORIENTATION FOR W WITH SPECIAL EMPHASIS TO THE VARIATION NEAR THE [110] ORIENTATION. Krahl-Urban, B.; Wagner, H. (Kernforschungsanlage, Juelich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Work function measurements on planar W single crystal samples were performed by thermionic emission. Apparent work function values ϕ^* and apparent emission constants A^* were obtained for various orientations between the [100] and the [110] direction. For the [110] direction and three well-defined directions tilted about 5° from the [110] direction work function values were determined by using the Richardson-Dushman equation and the Richardson constant $A = 120\ Acm^{-2}K^{-2}$. For the temperature range 2200 to 2450°K the following average values were obtained: [110], $\phi = 4.86$ eV; [650], $\phi = 4.66$ eV; [10,9,1], $\phi = 4.75$ eV; [15,15,2], $\phi = 4.67$ eV. The comparison between the work function values of the [110] direction with those of the three neighboring directions may be of value with regard to the preparation of CVD-chloride tungsten layers. The samples were obtained within $\pm\frac{1}{2}°$ of the desired direction. The residual gas pressure was 1×10^{-9} to 1×10^{-8} torr for the investigated temperature range. (auth)

10679 (CONF-720613-P3, pp 1385-1396) WORK FUNCTION CHANGE OF TUNGSTEN (110) PLANES AS FUNCTION OF Mo COVERAGE. Besocke, K. H. (Kernforschungsanlage, Juelich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The effect of Mo coverage in the submonolayer range on the work function change of the W (110) plane was investigated by using a LEED-Auger apparatus. At a residual gas pressure of 2×10^{-10} torr, the (110) plane of a high-purity W single crystal was covered with Mo by a flash-evaporation technique using a Mo filament source. The deposition rate and the corresponding Mo Auger signal was calibrated with a quartz microbalance. The Mo coverage was traceable down to 2% of a monolayer. Chemical surface analysis of the substrate before and during the evaporation

process was carried out by Auger electron spectroscopy and the surface structure analyzed by LEED. The work-function change as a function of Mo coverage was measured for sample temperatures of 20 and 750°C using retarded field methods. Starting from a clean surface, the work function dropped rapidly with increasing coverages reaching a saturation within 30% of a monolayer. The work-function change was 0.41 eV and 0.23 eV for 20 and 750°C, respectively. As the LEED pattern indicated, disordered and ordered surface structures of the deposited Mo were responsible for the different work function changes at 20 and 750°C. (auth)

10680 (CONF-720613-P3, pp 1397-1407) W (100) WORK FUNCTION CHANGE DURING ADSORPTION OF OXYGEN, CESIUM, AND OXYGEN–CESIUM CO-ADSORPTION. Desplat, J. L. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The work function determination by the Kelvin method was used to study the adsorption of oxygen, cesium, and co-adsorption of oxygen and cesium on a (100) tungsten surface at room temperature. The work function change with the oxygen exposure was used to calculate the initial sticking coefficient and the dipole moment of an adsorbed oxygen atom. The work function saturated value is 1.80 eV for Cs coated W surfaces. For oxygen adsorption on a cesiated surface, a 1.17 eV minimum was obtained under well-defined conditions. At oxygen saturation, the final work function decreased from 6.2 to 3.4 eV when the initial cesium coverage increased from 0 to 1. For cesium adsorption on an oxygenated surface, when the initial oxygen exposure was increased, the work function obtained after saturation with cesium, increased towards a 2.2-eV plateau, then moved down to 1.95 eV for very high initial oxygen exposures. On the other hand, at the same time, the work function minimum decreased to 1.1 eV, then moved up to 1.75 eV. (auth)

10681 (CONF-720613-P3, pp 1409-1422) THERMIONIC CHARACTERISTICS OF CARBURIZED TUNGSTEN–RHENIUM ALLOYS. Miyake, M.; Sano, T. (Osaka Univ.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In many refractory carbides the structural or constitutional changes affecting their thermionic characteristics are often observed to occur at a temperature of ~ 2000°K. Filaments of W–26% Re and W–19% Re (0.2 mm in dia) were carburized in propane at a pressure of about 3 torr and at filament temperature of 1600 to 1800°K. The carburizing behavior of the filament was followed by measurement of electric-resistivity change of the filament and was analyzed together with the result obtained by x-ray-diffraction patterns, metallographic observations, and microprobe examinations. Their thermionic characteristics were measured by the Langmuir method of constructing Schottky and Richardson lines. The initial work functions of the filaments carburized were considerably low values in the range from 2.5 to 3.8 eV. When the samples were heated at a temperature higher than 2000°K, the values of their work function in the first stage decreased to a minimum value of 2.2 to 2.6 eV, and in the second stage they increased more rapidly to a value higher than 4.5 eV. During these heating processes Richardson constants changed also in the similar manner to that of work functions. As far as the electric resistivity of the filaments, a remarkable change was not found in the first stage, while a striking decrease corresponding to the decarburization of the filament was observed in the second stage. From the result obtained it was deduced that the thermionic characteristics in the first stage were controlled mainly by any surface activation effect, and in the second stage they were determined by the decarburizing process. (auth)

10682 (CONF-720613-P3, pp 1435-1444) WORK FUNCTION MEASUREMENTS AT SIMULATED COLLECTOR CONDITIONS OF THERMIONIC DIODES. von Bradke, M. (Institut fuer Energiewandlung und Elektrische Antriebe, Stuttgart). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A new method for work-function measurements of electrodes in metal vapors is described. Using this method it is possible to extend the range of work function measurements to temperature and vapor conditions typical for collectors in thermionic converters. Contrary to well-known and usually used techniques for work-function measurements in metal vapors, such as the "filament diode technique" and the "plasma immersion technique", this method does not use the thermionic emission of the surface. It is a "contact potential difference method" (CPD) similar to the "electron beam retarding potential technique" developed by Shelton. This technique was improved for use in measurements in metal vapors and to simulate the real converter conditions at the dynamic equilibrium between the adsorption layer and the surrounding vapor. In order to obtain reproducible work function values of sufficient accuracy at low sample temperature, severe problems with the measuring device had to be solved and extreme requirements on residual gas pressure, cleanliness of the surfaces, and purity of the adsorption vapors have to be satisfied. Previous to the first experiments with barium and cesium adsorption layers, measurements of the vacuum work function of some refractory metals were carried out to test the device. Comparison with published data from other sources indicated a satisfactory agreement. Reproducibility and accuracy of the results were excellent due to the possibility to produce clean surfaces and to keep them clean during the measuring time. Measurements with metal vapors were carried out on the Ba–W and the Ba–Cs–W adsorption systems. These investigations are of particular interest for thermionic converter work concerning mixed vapor diodes and the influence of additives. (auth)

10683 (CONF-731104-8) EXCHANGE INTERACTION IN DILUTE YTTRIUM-RARE EARTH ALLOYS. Nicklow, R. M.; Wakabayashi, N. (Oak Ridge National Lab., Tenn. (USA)). 1972. 8p. Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

Dilute alloys of the heavy rare earths Gd, Tb, Dy, and Ho in yttrium all exhibit the identical type of helical long-range magnetic order at low temperature. This fact suggests that the magnetic order in these alloys is determined predominantly by the RKKY exchange interaction $J(q)$ which is proportional to the susceptibility $\chi(q)$ for the conduction electrons of yttrium. In order to obtain information about $J(q)$, the magnetic excitations in the c-direction of Y(10%Tb) and Y(10%Ho) were studied at 4.7°K by means of neutron inelastic-scattering techniques. In spite of the low concentration of magnetic atoms, well-defined propagating excitations were observed for both alloys. The data were analyzed on the basis of a model in which the equations of motion for spins are averaged over randomly distributed sites of magnetic atoms with the assumption that $J(q)$, properly normalized, is common to both alloys. The results show this to be a reasonably good assumption, and the resulting $J(q)$, which may be interpreted to be characteristic of Y, shows a peak at the wave vector of the helical structure which is much larger than those measured in the pure rare earth metals. (auth)

10684 (COO-1676-31) DISLOCATION–SOLUTE ATOM INTERACTIONS IN ALLOYS. Technical Progress Report, February 1, 1973–January 31, 1974. Gibala, R.; Vasudevan, A. K.; Sethi, V. K.; Slane, J. A.; Krupitzer, R. P. (Case Western Reserve Univ., Cleveland, Ohio (USA). Div. of Metallurgy and Materials Science). 31 Oct 1973. Contract AT(11-1)-1676. 32p. Dep. NTIS $3.75.

Research is reported in: alloy hardening and softening in bcc metals, effects of solute gradients on strengthening in bcc materials (O in Nb), mechanical behavior of hydrogenated bcc metals, carbon-vacancy interactions in austenitic alloys, and Snoek anisotrophy in bcc metals. (10 figures, 40 references) (DLC)

10685 (COO-2037-14) ELECTROTRANSPORT IN LIQUID METALS. Final Report. Rigney, D. A. (Ohio State Univ. Research Foundation, Columbus (USA)). Nov 1973. Contract AT(11-1)-2037. 83p. Dep. NTIS $6.25.

Calculations were based on scattering theory and experiments using the capillary-reservoir technique. Agreement of predicted behavior with available experimental data is good, especially for the direction of migration of a component or the presence or absence of a migration reversal. Experimental work concentrated on the systems Na–K, Na–Rb, Li–Ag, Cu with V, Cr, Mn, Fe, Co, or Ni, and Al with Ti, Cr, Mn, Fe, Co, and Ni. Calculations for monovalent systems indicate that a wide variety of electrotransport behavior is expected, with large or small effects, with or without migration reversals, and with little or appreciable variation with composition. Several new methods for accurately measuring the composition of electrotransport reversal have been proposed and tested. (31 figures, 97 references) (auth)

10686 (EUR-5025) DEVELOPMENT AND STUDY OF FOUR NEW ZIRCONIUM ALLOYS. Boerman, D. J.; Bonnet, P.; Imarisio, G. C.; Barigozzi, F.; Brera, C.; Quinto, A. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Nov 1973. 95p. (In Italian). Dep. NTIS (U.S. Sales Only) $6.75. EUR FB 125,-.

Zr–1.4% Cr, Zr–0.8% V–0.8% Fe, Zr–0.8% Cu–0.4% Fe, and Zr–1.3% Cu–0.4% Fe, are characterized, mainly the mechanical properties. After determination of the recovery and recrystallization behavior, a production sheet was defined, resulting in 2-mm thick sheets in the fully recrystallized state. Tensile properties at 20, 400, and 500°C and creep properties at 400 and 500°C were

determined and a series of hot microhardness tests were initiated. The influence of hydrogen concentrations—mainly between 20 and 200 ppM with some tests to 500 ppM—on the mechanical properties was also verified. The four new alloys can be divided into two groups concerning the mechanical properties, especially the creep properties: 1) more-resistant: Zr–1.4% Cr and Zr–0.8% V–0.8% Fe; 2) less-resistant: Zr–0.8% Cu–0.4% Fe and Zr–1.3% Cu–0.4% Fe. However, in the fully recrystallized state, the four new alloys have mechanical properties inferior to Zircaloy-2 and especially to Zr–2.5% Nb. (15 tables, 39 figures) (auth)

10687 (HEDL-TME-73-65) CREEP OF 20% C.W. TYPE 316 STAINLESS STEEL. Lovell, A. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 72p. AT.

The flow behavior of 20%-cold-worked Type-316 stainless steel was evaluated from well over 100 creep and tensile tests. The time-dependent (creep) behavior was reduced to a mathematical expression that includes stress- and temperature-dependent parameters to describe the strain as a function of time for temperature from 1000 to 1400°F and stress to the proportional elastic limit. The measured versus calculated strains are compared at constant times and at constant stresses. The calculated strain, using the expression $[\epsilon_c = \epsilon_x [1 - \exp(-ST)] + \epsilon_t [1 - \exp(rt)] + \dot{\epsilon}_m t]$ as a function of stress, temperature, and time is included as an appendix. (auth)

10688 (HEDL-TME-73-84) PERFORMANCE TESTS OF METAL OXIDE INSULATED COAXIAL CABLES FOR REACTOR INSTRUMENTATION APPLICATION. Potter, D. W.; Philipp, L. D.; Muhlestein, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 62p. AT.

Twelve coaxial cables with stainless steel conductors and various metal oxide insulation were tested as a function of voltage and temperature. An alumina cable showed the largest voltage–temperature profile for breakdown pulse noise (BPN) threshold, while a beryllia cable showed the highest resistivity as a function of temperature. Other insulation types tested were hafnia, silica, thoria, and zirconia. Silica-insulated cables also performed well when compared with those insulated with alumina and beryllia. (auth)

10689 (JPRS-60622) INVESTIGATION OF MUTUAL DIFFUSION IN NICKEL–TUNGSTEN AND PALLADIUM–TUNGSTEN SYSTEMS. Pimenov, V. N.; Ugaste, Yu. E. Translated from Fiz. Metal. Metalloved.; 35: No. 3, 590-596(1973). 9p. NTIS.

Mutual diffusion was studied in Ni- and Pd-base binary solid solutions of Ni-W and Pd-W systems. It was found that the relations between concentration values in the parameters for mutual diffusion, activation energy, frequency factors, and solidus temperature can be established. (JRD)

10690 (JUL-942-FF) INVESTIGATION OF LATTICE DISTORTIONS OF OXYGEN INTERSTITIALS IN NIOBIUM BY X-RAY SCATTERING. Wombacher, P. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). Apr 1973. 69p. (In German). Dep. NTIS (U.S. Sales Only) $5.50.

Thesis. Submitted to Technische Hochschule, Aachen, Ger.

Niobium single crystals were filled with oxygen at 1.35 to 8.2 atoms per thousand. The concentrations were determined by measuring the change of lattice parameters and were confirmed by chemical analysis. The given value at room temperature of 20.8 eV for the trace of the double force tensors increases according to these measurements to 22.6 eV at 10°K. The diffuse x-ray scattering was measured on these samples in the vicinity of the Bragg reflections 110, 200, 220, and 400 in directions parallel and perpendicular to the scattering vector at 10°K. These reflections were investigated by transmission on the corresponding samples. It was found that by measuring the diffuse scattering, the far-reaching displacement field around the defects can be determined. Contrary to theory, the stronger than linear increase in intensity with oxygen concentration can be traced to a small share of double and triple clusters. The defect state investigated exhibited a tetragonal symmetry; the off-diagonal components of the double force tensor can be neglected at low concentrations; at larger concentrations, a notable contribution can be observed due to interaction of the displacement fields. The thus-found anisotropy 7.3 eV ± 6% at 10°K is in good agreement with Snoek effect measurements at 457°K (6.9 eV ± 7%). Besides the contribution in the q-symmetrical share of the diffuse scattering, an asymmetric contribution occurred, which can be attributed to the displacements in the immediate vicinity of the defect center and to the scattering factor of the foreign atom. On the whole, the results indicate that the oxygen in the concentration range investigated occupies the octahedral position. (GE)

10691 (NRCN-334) MICROSTRUCTURE OF Be–Cu ALLOY SHEETS AFTER HEAT TREATMENTS AND WELDING. Stern, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Nov 1972. 26p. (In Hebrew). INIS.

The microstructure of Be–Cu alloys (Berylco-25), solution-heat-treated and aged, was investigated. The structure was revealed after mechanical polishing and chemical etching, and electrolytic and chemical polishing and etching. The latter two processes disclosed annealing twins in the microstructure. The electrolytic process seems to work best for specimens thicker than about 2 mm. The microstructure of the weld and its heat-affected zone, in Berylco-25 after various heat treatments, was investigated. For 1-mm-thick sheets, solution heat treatment is not recommended after welding, because of the noticeable grain growth in the heat affected zone. The aging process should be sufficient to achieve best mechanical properties. (auth)

10692 (ORNL-TM-4380) INFLUENCE OF AGING ON THE IMPACT PROPERTIES OF HASTELLOY N, HAYNES ALLOY NO. 25, AND HAYNES ALLOY NO. 188. McCoy, H. E.; Bourgette, D. T. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $3.75.

Samples of Hastelloy N and Haynes alloy Nos. 25 and 188 were solution annealed, aged at temperatures over the range 650 to 900°C, and impact tested at 25 and 300°C. The impact energy decreased for most aging conditions, with the property changes being least for Hastelloy N and greatest for Haynes alloy No. 25. Small aged tensile samples showed that aging reduced the fracture strain at 25°C. The fractures of the tensile samples were examined, and some of the notched impact specimens were viewed optically. The reduction in toughness of Hastelloy N correlated well with the amount of grain boundary precipitate. Haynes alloys Nos. 25 and 188 formed carbides and Laves phase. These alloys had a strong tendency to fracture intergranularly even in the solution-annealed condition. The tendency increased with aging, and the increased amounts of grain boundary precipitate likely account for the reduction in toughness. (auth)

10693 (ORNL-TM-4423) ISOTOPIC POWER MATERIALS DEVELOPMENT PROGRESS REPORT FOR NOVEMBER 1971. Donnelly, R. G. (Oak Ridge National Lab., Tenn. (USA)). 26 Nov 1973. 15p. Dep. NTIS $3.00.

Data are given on bend testing of Pt–Rh–W alloys; tensile properties of Pt–Rh–W alloys with and without Hf and Ti additions; tensile properties of recrystallized Ir; effects of contamination by gases (oxygen, degassed impurities, water vapor, CO) on the tensile properties of T-111, TZM, and Mo–46% Re; and fractography and bend testing of T-111 from Pioneer heat source capsules. (DLC)

10694 (RD/B/N-2560) LOW-TEMPERATURE DIFFUSION OF CHROMIUM IN FINE-GRAINED 20/25/Nb STEEL WITH VARYING DISLOCATION DENSITIES. Smith, A. F. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 19p. Dep. NTIS (U.S. Sales Only) $3.00.

Chromium tracer diffusion in fine-grain 20/25/Nb stainless steel with varying dislocation densities was analyzed using exact solutions to the grain-boundary and dislocation problem. The tracer concentration profiles below 700°C could be explained using a lattice-diffusion coefficient extrapolated from high-temperature results together with a dislocation component. This dislocation component was dominant at short times and led to an apparent enhancement of the lattice-diffusion coefficient. It is postulated that the dislocation pipe diffusion coefficient is several orders of magnitude lower than the grain-boundary diffusion coefficient at the temperatures studied. The ratio D_p/D_L at these temperatures was not sufficiently high for enhancement of the lattice-diffusion coefficient, according to the Hart model, to occur, even at high dislocation concentrations. (auth)

10695 (RDT-M-2-1-T(11-73)) CARBON STEEL FORGINGS (ASME SA-105 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1973. 9p. RSO.

A standard prescribing requirements for carbon steel (ASME SA-105 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2–1T, dated July 1971. (JRD)

10696 (RDT-M-2-6-T(11-73)) MARTENSITIC STAINLESS STEEL (TYPE 403) FORGINGS (ASME SA-182 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1973. 10p. RSO.

A standard prescribing requirements for martensitic stainless steel (Type 403) forgings (ASME SA-182) with additional requirements for nuclear and associated applications is presented. This standard supersedes RDT M2–6T, dated July 1971. (JRD).

10697 (RDT-M-3-6-T(11-73)) AUSTENITIC STAINLESS STEEL PIPE (ASME SA-312 WITH ADDITIONAL REQUIREMENTS).

(USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1973. 9p. RSO.

A standard prescribing requirements for austenitic steel pipe (ASME SA-312 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M3-6T, dated June 1972. (JRD)

10698 (RDT-M-3-11-T(11-73)) CARBON AND LOW ALLOY STEEL WELDED PIPE (ASME SA-155 WITH ADDITIONAL REQUIREMENTS). (USAEC Division of Reactor Research and Development, Washington, D.C.). Nov 1973. 8p. RSO.

A standard prescribing requirements for carbon and low alloy steel welded pipe (ASME SA-155 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M3-11T, dated July 1971. (JRD)

10699 (SJE-138) PROPERTIES OF AUSTENITIC STAINLESS STEEL FOR NUCLEAR REACTORS. Matejovic, K.; Staif, M. (Skoda, Plzen (Czechoslovakia)). 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

The properties of an austenitic chromium–nickel stainless steel alloyed with small quantities of molybdenum, niobium, and trace additions of zirconium and cerium were investigated. The steel was manufactured in the size of an ingot 13 tons in weight and shaped into a plate 60 mm in thickness. Mechanical properties as a function of the temperature are given, and the thermal treatment of both the base material and the welded joints is discussed. The structural changes and the characteristics of the process of precipitation of carbide phases as well as their influence on resistance to intercrystalline corrosion in the heat-affected zone of the welded joints are also described. (auth)

10700 (SLA-73-1053) EXAMINATION OF SPR-II FUEL. Horak, J. A.; Rhude, H. V.; Sasmor, D. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. Contract AT(29-1)-789. 91p. Dep. NTIS $6.75.

To optimize the fuel performance in the SPR-II and SPR-III reactors, a program of pre-irradiation examination of reactor fuel components has been implemented. The most information obtained by nondestructive testing (NDT) combined with ease of measurement is with ultrasonic back reflection and immersion density measurements. Porosity that was detected in some fuel components by NDT has been eliminated in recent fuel components by increasing the amount of metal in the casting and modification of the casting procedures. For two fuel components that developed cracks after a short operational history in the reactor, optical and scanning electron metallography revealed some porosity and an extensive grain-boundary phase that was analyzed to be primarily UC. Results of chemical analyses indicated that the carbon content was considerably in excess of the specified maximum for SPR-II fuel components. The cracking was attributed to the excess carbon, which resulted in an almost-continuous brittle grain-boundary phase of UC. Recommendations and current efforts to optimize the fuel performance in fast burst reactors are presented. (auth)

10701 TEMPERATURE DEPENDENCE OF THE CRYSTAL-FIELD-INDUCED ANISOTROPY IN $SmFe_2$. van Diepen, A. M. (Philips Research Labs., Eindhoven, Netherlands); de Wijn, H. W.; Buschow, K. H. J. Phys. Rev., B; 8: No. 3, 1125-1129(1 Aug 1973).

For the compound $SmFe_2$, ^{57}Fe Moessbauer spectra were obtained at various temperatures between 5 and 300°K. The axis of easy magnetization changes from [011] below about 175°K to [111] above this temperature. The single-ion crystal-field magnetic anisotropy of Sm^{3+} was calculated with inclusion of effects of exchange, and this model was found to account well for the transition in the direction of easy magnetization. (auth)

10702 PdV: A SYSTEM WITH A HIGH SPIN-FLUCTUATION OR KONDO TEMPERATURE. Kao, F. C. C.; Colp, M. E.; Williams, G. (Univ. of Manitoba, Winnipeg). Phys. Rev., B; 8: No. 3, 1228-1238(1 Aug 1973).

The temperature dependence of the incremental resistivity $\Delta\rho(T)$ of five dilute PdV alloys, ranging in concentration from 0.15 to 1.0 at. % V, was measured from 1.4 to 300°K. $\Delta\rho(T = 0)$ increases linearly with V content at a rate of 3.26 ± 0.13 $\mu\Omega$ cm/at. % V. Between 10 and 80°K, $\Delta\rho(T)$ increases rapidly with increasing temperature, in a manner characteristic of Matthiessen's-rule breakdown resulting from phonon and impurity scattering with differing anisotropies. Above 80°K, however, $\Delta\rho(T)$ decreases smoothly with increasing temperature; various attempts were made to fit this high-temperature variation: (i) In terms of a localized-spin-fluctuation (lsf) model, these data are well fitted by $\Delta\rho(T) = C + D \ln[(T^2 + \theta^2)^{1/2}]$, with lsf temperature θ estimated at about 160°K for isolated impurities. D, however, does not scale linearly with the V concentration c, and it is necessary to postulate that interimpurity interactions significantly raise θ for the interaction pair, then $D \propto c(1-c)^n$. The observed variation of D can be approximately reproduced for n = 150. (ii) These high-temperature data are also equally well fitted by the Appelbaum–Kondo expression: $\Delta\rho(T) = E\{1 - (16\cos 2\delta_v/3\cos^2\delta_v)[(T/T_K)\ln(T/T_K)]^2\}$. The scaling parameter E increases linearly with c and the Kondo temperature T_K is estimated at about 2300°K. Possible variations in the potential phase shift δ_v indicate that the amount of s-band screening may increase as c increases. Further experiments are necessary, however, to determine the eventual applicability of either model. Finally, estimates are made of the Matthiessen's-rule deviations $\Delta(T)$, which are then fitted within the framework of a "parallel conduction" model, in which $1/\Delta(T) = 1/\alpha\rho_h(T) + 1/\beta\rho_l(T)$. $\rho_h(T)$ is the host and $\rho_l(T)$ the impurity resistivity. A concentration-independent value for α of 0.31 ± 0.04 is obtained, but β is found to vary with concentration around a value of 0.06. (35 references, 9 figures) (auth)

10703 MAGNETO-OPTIC KERR EFFECTS IN GADOLINIUM. Erskine, J. L.; Stern, E. A. (Univ. of Washington, Seattle). Phys. Rev., B; 8: No. 3, 1239-1255(1 Aug 1973).

Samples prepared by vacuum evaporation were studied in situ under ultra-high-vacuum conditions to ensure clean optical surfaces. Magneto-optic Kerr rotation and ellipticity, determined using a null-type ellipsometric method, are used to calculate the magnetic contribution to the conductivity tensor. Data cover the 1- to 5-eV range at several temperatures. A simple model based on band calculations is used as a basis for interpretation of the data. The magneto-optic absorption is shown to have an intraband component and an interband component in analogy with ordinary optical absorption. A phenomenological intraband theory of the magneto-optic Kerr effect is presented and used to subtract out the intraband contribution from experimental data. Structure observed in the interband magneto-optic contribution to the conductivity is discussed in terms of p → d and d → f transitions. Numerical estimates of the signs and weights of these transitions are made in order to support this interpretation. A number of experimentally determined parameters associated with the band structure of Gd result from this work including d bandwidth and general shape, location of unoccupied 4f states above the Fermi level, and the amount of "p character" in occupied bands. It is found that the unoccupied d bands have sharper structure and only qualitative agreement in the placement of the peaks compared to band calculations. The unoccupied 4f states are at a higher energy than predicted by calculations. (16 figures, 31 references) (auth)

10704 EFFECT OF ULTRASONIC IRRADIATION ON THE DEVELOPMENT OF TWINNING IN CADMIUM. Gindin, I. A.; Volchok, O. I.; Neklyudov, I. M. (Physical-Technical Inst., Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2762-2763(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3245-3247(Nov 1972).

The influence of ultrasonic irradiation (20 kHz) on statically pretwinned cadmium polycrystalline samples was studied. It is shown that ultrasonic irradiation produces a deformation localization zone at the incoherent twin–matrix interface, strongly affecting the subsequent growth of the twin layer under the action of static loading. (auth)

10705 INFLUENCE OF ISOTOPIC SCATTERING ON THE THERMOELECTRIC POWER OF METALS. Ermolaev, A. M. (Kharkov State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2904(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3440-3441(Nov 1972).

The similarity law is derived: $Q_i(T) = \sqrt{M_1/M_i}\,Q_1(T_i')$, where Q_i is the thermoelectric power of a perfect metal composed of atoms of mass M_i. When $T \ll \Theta$, the power is $Q_0 = \pi^2 T/3e\zeta$; thus, at very low T, Q is independent of the isotopic composition, and the same result is obtained for $T \gg \Theta$, where $Q = 3Q_0$. The isotopic composition exerts an influence only at intermediate temperatures, at which Q depends nonlinearly on T. (DLC)

10706 MAGNETIZATION AND PINNING IN SINGLE-CRYSTAL 70 Ta–30 Nb ALLOY. Magradze, O. V.; Chigvinadze, D. G. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 1, 32-34(Jul 1973).

Translated from Fiz. Tverd. Tela; 15: No. 1, 48-51(Jan 1973).

An investigation was made of the influence of plastic deformation by 4 and 42% on the magnetization of the single-crystal superconductor $Ta_{70}Nb_{30}$. The bulk pinning force was deduced from the hysteresis of the magnetization curves. The hysteresis and the pinning force increased strongly in the case of weak deformation ($\Delta l/l = 4\%$) and increased weakly in the case of strong deformation ($\Delta l/l = 42\%$). The pinning force determined in this way was in order-of-magnitude agreement with the results obtained for the same crystals by a mechanical method. (auth)

10707 PHOTOELECTRON SPECTRUM AND STRUCTURE OF THIN Tb FILMS. Strakovskaya, S. E.; Nemchenok, R. L.; Voronin, Yu. M. (Leningrad Polytechnic Inst.). Sov. Phys. Solid State (Engl. Transl.); 15: No. 1, 135-137(Jul 1973).

Translated from Fiz. Tverd. Tela; 15: No. 1, 197-200(Jan 1973).

Experimental data on the spectra of photoelectrons emitted from thin Tb films were compared with electron photomicrographs. An analysis was made of the possible influence of the surface and of the particle size on the photoelectron spectrum. (auth)

10708 INVESTIGATION OF HYPERFINE INTERACTIONS IN SAMARIUM-COBALT COMPOUNDS BY THE MOESSBAUER METHOD. Belozerskii, G. N.; Belyanina, N. V.; Ivanova, I. N.; Tsaturyan, S. A.; Shapiro, A. I. (Leningrad State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 15: No. 1, 223-224(Jul 1973).

Translated from Fiz. Tverd. Tela; 15: No. 1, 305-307(Jan 1973).

The compounds Sm_2Co_{17}, $SmCo_5$, Sm_2Co_7, $SmCo_3$, and $SmCo_2$ were doped with ^{57}Fe. The isomeric shifts all are close to one another, indicating identical electron configurations of the Fe atoms in all positions. The positions at which the number of Sm atoms near Fe varies are: 9(d) in Sm_2Co_{17} (2 Sm atoms); 18(h) in Sm_2Co_{17} (3 Sm atoms); 3(d) in $SmCo_5$ (4 Sm atoms); 18(h) in Sm_2Co_7 (5 Sm atoms). The effective magnetic field at ^{57}Fe is plotted versus the number of Sm atoms near Fe. The line intensities differed from the populations. The magnetic moments of the Co atoms are parallel to each other. (DLC)

10709 NUCLEAR MAGNETIC RESONANCE OF ^{51}V NUCLEI IN VANADIUM-RICH Fe-V ALLOYS. Repnikov, S. P.; Ustinov, V. B. (Leningrad Inst. of Electrical Engineering). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 9, 2375-2377(Mar 1973).

Translated from Fiz. Tverd. Tela; 14: No. 9, 2749-2751(Sep 1972).

The NMR line profile of ^{51}V in alloys containing 15 to 39 wt % V was studied using the spin-echo method. The local field at the ^{51}V nucleus was plotted versus the V content in the alloys; the curve is in agreement with the assumption that the internal field is a linear function of the average magnetic moment up to 25% V. Longitudinal and transverse relaxation times were measured: T_1 = 1 to 1.2 ms and T_2 = 300 to 400 ms for all compositions. T_1T = 0.3 to 0.4 and the rate of relaxation was three to four times higher than in paramagnetic alloys. (DLC)

10710 INTERPRETATION OF SOME FEATURES OF PLASMA LOSS PEAKS IN THE SPECTRA OF ELECTRONS REFLECTED FROM Mo. Zashkvara, V. V.; Red'kin, V. S. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 9, 2410-2411(Mar 1973).

Translated from Fiz. Tverd. Tela; 14: No. 9, 2781-2783(Sep 1972).

The dependence of the energy positions of E_1 and E_2 peaks in the characteristic energy-loss spectra of Mo on the scattering angle φ (26 to 141°) was studied for a primary electron energy of 800 eV. Results show that E_1 is constant, but E_2 increases with φ, reaching saturation at ~80°. This can be explained by assuming that each peak is the sum of two plasma peaks (volume and surface). (DLC)

10711 INTERNATIONAL UNION OF CRYSTALLOGRAPHY. Ninth International Congress. Communicated Abstracts. Hoshino, S. (Ed.). (Tokyo Univ.). Acta Crystallogr., Sect. A; 28: No. 4, S1-S303(15 Jul 1972). (In Several Languages).

Abstracts of papers communicated to the conference (Ninth International Congress of Crystallography of the International Union of Crystallography, held in Kyoto, Japan, 26 August-7 September 1972) are compiled here. (DE)

10712 MOESSBAUER EFFECT OF Fe-V AND Fe-Cr SIGMA PHASE. Sumitomo, Y.; Moriya, T.; Ino, H.; Fujita, F. E. (Osaka Univ., Suita, Japan). J. Phys. Soc. Jap.; 35: No. 2, 461-468(Aug 1973).

The magnetic properties and bonding natures of the Fe-V and Fe-Cr σ phase were studied by the Mössbauer effect and saturation magnetization measurements. The Mössbauer absorption spectra of the Fe-V σ-phase alloys measured at 77°K showed the hyperfine broadening due to overlapping of small internal magnetic fields. Each spectrum was decomposed into four components: The internal magnetic field on one site (I site) is nearly zero, and those on the other three sites (III, IV, and V site) vary from 61 to 135 kOe, 16 to 65 kOe, and 38 to 103 kOe, respectively, with increasing iron composition. Applying the modified Pauling valence model developed by Mori and Mitsui, the obtained values of the internal fields were explained and, therefore, the covalent bonding nature in this structure was confirmed. In the Fe-Cr σ phase containing 46.8 at.% Cr, hyperfine broadening was observed at 4.2°K, and a similar analysis and discussion are made. (auth)

10713 ANGULAR DEPENDENCES OF THE ENERGY SPECTRA OF THE ION COMPONENT IN THE CATHODIC SPUTTERING OF POLYCRYSTALLINE MOLYBDENUM WITH Cs^+ IONS. Adylov, A. A.; Veksler, V. I.; Reznik, A. M. (Tashkent State Univ.). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2696-2699(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3151-3156(Nov 1972).

An experimental investigation was made of the deformation of the energy spectra of the ion component of the cathodic sputtering resulting from changes in the angles between the momentum of the sputtered Mo^+ ions and either 1) the momentum of the primary 2100-eV Cs^+ ions (ψ_0), or 2) the normal to the surface of the plane polycrystalline Mo target (r). The nature of the deformation of the spectra resulting from changes in ψ_0 was in agreement with the cascade-focuson theory of the energy spectra of the products of cathodic sputtering. A correction term refining this theory was derived. It was assumed that the ions produced by sputtering were due to the nonadiabatic nature of the motion of the sputtered particles leaving the bombarded surface. On this assumption the experimentally observed dependence of the spectra on changes in r was in agreement with the theory of ionization due to nonadiabatic motion put forward by Veksler (1959) but not with the theory of Trubnikov and Yavlinskii (1967). (auth)

10714 STANDARD GIBBS ENERGY OF FORMATION OF U_3Co_{11} FROM SOLID-STATE EMF MEASUREMENTS. Yoshihara, K.; Kanno, M. (Tokyo Univ.). J. Inorg. Nucl. Chem.; 36: No. 1, 226-227(Jan 1974).

The standard Gibbs energy of formation of U_3Co_{11} was determined with a galvanic cell using a solid calcium fluoride electrolyte. Calcium fluoride is an ionic conductor over the temperature range of the measurements. The construction of the fluorine concentration cell was as follows:

$$U,\ UF_3 \mid CaF_2 \text{ (single crystal)} \mid UF_3,\ U_2CO_{11},\ Co.$$

From the emf values, the standard Gibbs energy of U_3Co_{11} was calculated as follows:

$$\Delta G_f^\circ(U_3Co_{11}) = -3.42 \times 10^{-3}T - 49.50 \text{ kcal/mol (993 to 1053 K)}$$

$$= -1.10 \times 10^{-3}T - 51.94 \text{ kcal/mol (1053 to 1153 K).}$$

(UK)

10715 ELECTRON SPIN RESONANCE OF Gd IN INTERMETALLIC COMPOUNDS YAg AND GdAg. Weimann, G. (Technische Univ., Darmstadt, Ger.); Bopp, P.; Elschner, B.; Buschow, K. H. J. Int. J. Magn.; 5: No. 1-3, 1-3(1973).

Presious ESR investigations on Gd-doped YAg were extended to higher Gd concentrations. It is shown that increasing Gd concentration leads to a sign reversal for the g-shift accompanied by a decreasing line width. The experimental data are explained by a two-band model that allows for a relaxation of the Gd spin to s-electrons as well as to d-electrons. (auth)

10716 WORK FUNCTIONS OF RHENIUM AND TUNGSTEN DETERMINED BY THERMIONIC AND MASS SPECTROMETRIC MEASUREMENTS. Chao, B. Y. K. Troy, NY; Rensselaer Polytechnic Inst. (1973). 121p. University Microfilms Order No. 73-27,198.

Thesis (Ph. D.).

Measurements were made of the changes in the effective work function of polycrystalline tungsten, rhenium, and tungsten-rhenium alloys at high temperatures, as a function of the ambient oxygen pressures in the range of 10^{-8} to 10^{-5} torr. Experimental data from both methods in the temperature range of 1700 to 2150°K yielded consistent work function values for the pure metals. A maximum work function increase about 0.7 eV was noted for both tungsten and rhenium at 1710°K at 10^{-5} torr, compared to 10^{-8} torr. In the case of the alloys, there is a large difference in the effective work function change found from the thermionic and mass spectrometric measurements. In general, however, the ion emission is dominated by the high work function element, while the electron emission is dominated by the low work function metal. A single rhenium specimen was ion implanted with cesium atoms, at a "doping" density of 5×10^{15} atoms/cm^2 and with an energy of 60 keV. A large work function increase was noted, based on thermionic measurements only. This anomaly cannot be explained adequately. (Diss. Abstr. Int., B)

10717 STUDY OF THE DISSOLUTION AND HOMOGENIZATION BEHAVIOR OF BINARY SYSTEMS WITH INTERMEDIATE PHASES. Lanam, R. D. Jr. Philadelphia; Drexel Univ. (1973). 119p. University Microfilms Order No. 73-25,533.

Thesis (Ph. D.).

Mathematical modeling of three-phase, binary, diffusion-controlled systems has defined the major variables involved in the homogenization of such systems for planar, cylindrical, and spherical geometries. Experimental data were obtained for the Mo-Ni system (multilayered diffusion couples and blended elemental compacts) to determine if the variables studied by modeling adequately

accounted for the homogenization behavior of the system. The variables studied experimentally included diffusion time, temperature, particle size, initial density, mean composition, and pressure applied during homogenization. The couples and compacts were evaluated by the use of quantitative metallography, x-ray compositional line broadening, and electron probe microanalysis. Results were compared to the mathematical model in terms of normalized phase thickness and concentration. Good agreement was obtained when the mathematical model and the experimental data for the multilayered diffusion couples were compared. The agreement of the model and data for the blended, elemental powder compacts was found to be strongly dependent upon the mean concentration. Good agreement was found for the 5 wt % Mo compacts. Increasing the mean concentration to 15 and 30 wt % Mo resulted in increasingly larger deviations from the model. The effect was attributed to nonideal mixing of the component powders. Diffusion of multilayered diffusion couples was carried out for the Al–Ni system. Couples with mean compositions in each of the intermediate-phase fields were fabricated and studied. The finite couples indicated that the fluxes affected the "missing" phases. Dissolution of the (Ni)-, (Al)-, and β-phases was compared to the appropriate three-phase model with some success. In general, the study defined the major variables controlling homogenization and dissolution of binary systems with intermediate phases present. However, caution should be exercised in applying the modeling, especially to powder compacts with large mean compositions. (Diss. Abstr. Int., B)

10718 TITANIUM–, ZIRCONIUM–, AND HAFNIUM–MERCURY SYSTEMS. Lugscheider, E.; Jangg, G. (Technische Hochschule, Vienna). Z. Metallk.; 64: No. 10, 711-715 (Oct 1973). (In German).

Vapor-pressure measurements and x-ray studies of titanium, zirconium, and hafnium amalgams yielded data for the clarification of the mercury–IVA metal systems. In the Ti–Hg system, the known compounds TiHg and Ti_3Hg were found. Ti_3Hg occurs only in one modification; the theta-Ti_3Hg phase, previously considered to be a high-temperature modification, is actually Ti_3HgO. A further phase occurs in the Ti–Hg system which has two modifications with a transition temperature of about 300°C. Above 300°C, the phase encompasses a very broad composition region (from $TiHg_{0.915}$ to $TiHg_{0.577}$), and this region narrows markedly below 300°C. Adjacent to this, there apparently exists another phase, richer in mercury than TiHg, which decomposes peritectically at 128°C. In the Zr–Hg system, only the three previously recognized Zr–Hg compounds were observed, which are stable over large temperature ranges. Hafnium forms only one compound with mercury, Hf_3Hg, which decomposes peritectically at approximately 450°C. From the results of the vapor-pressure measurements, thermodynamic data for the mercury compounds of the IVA metals could be calculated. All compounds have relatively low heats of formation. (GE)

10719 ELECTROCHEMICAL OSCILLATION METHOD FOR STUDYING THE DIFFUSION OF HYDROGEN IN METALS (Pd, Pd–Ag, Nb, Ta). Boes, N.; Westerboer, U.; Zuechner, H. (Univ., Muenster, Ger.). Ber. Bunsenges. Phys. Chem.; 77: No. 9, 708-711(1973). (In German).

A new method for investigation of diffusion of hydrogen isotopes (H,D) in fcc and bcc metals is described. This method was developed from well-proven pulse methods. A metal foil is connected in a control circuit of a potentiostat so that the diffusion impedance and the feedback will cause stationary relaxation oscillations of the potential, i.e., the hydrogen concentration, around a pre-selected value. A solution of the diffusion problem is given, showing the relation between the diffusion coefficient D and the time of oscillation τ: $D = s^2/1.778 \times \tau$. Diffusion coefficients of H in Pd, Pd/Ag, Nb, and Ta obtained by this method are discussed and compared with those obtained by electrochemical pulse methods. (GE)

10720 TEMPERATURE DEPENDENCE OF HARDNESS OF PRECIPITATION-STRENGTHENED MOLYBDENUM. Alfintseva, R. A.; Borisenko, V. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 65-69(Oct 1973). (In Russian).

Additions of 4 vol % of disperse particles of oxides Al_2O_3, TiO_2, ZrO_2, HfO_2, and nitrides AlN, TiN, ZrN, HfN to molybdenum do not change the general character of the temperature dependence of its hardness, which in semi-logarithmic coordinates assume a linear character with two bends at the straight line: the low-temperature T_1 and high-temperature T_2. The temperature T_1 is determined by dispersity, and T_2 by the nature of the second phase. The degree of hardness increase is determined by particle dispersity at all temperatures: the smaller particles of the second phase, the higher the hardness. (auth)

10721 FATIGUE AT ELEVATED TEMPERATURES. Symposium Held at Storrs, Connecticut, June 18–23, 1972. Carden, A. E.; McEvily, A. J.; Wells, C. H. (eds.). ASTM Special Technical Publication 520. Philadelphia; American Society for Testing and Materials (1973). 810p. (ASTM-STP-520; CONF-720622-). $45.50.

A total of 58 papers and related discussions is presented, arranged into sections dealing with mechanisms of fatigue, test methods, materials, thermal ratchetting, and lifetime predictions and design. (DLC)

10722 EFFECTS OF DEUTERIDE PRECIPITATION IN TANTALUM BY FREQUENCY AND INTERNAL FRICTION MEASUREMENTS. Cannelli, G.; Cantelli, R.; Corbino, O. M. (CNR, Rome). (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

The effects of deuteride precipitation from Ta–D solid solution was investigated by vibration frequency and internal friction measurements in the temperature range 80 to 300°K. Initiation of deuteride precipitation is indicated by the inflexion of frequency curve, whilst the onset of the dislocation loops formation around the deuteride particles is correlated with the internal friction growth (precipitation peak). The dislocation interstitial drag model, which seems to better account for the precipitation peak, is discussed. The phase diagram of the Ta–D system was determined in the range 0.2 to 7.5 at.%. (GE)

10723 FERRITIC STAINLESS ALLOYS CONTAINING TITANIUM AND MOLYBDENUM AS MAJOR ALLOYING ADDITIONS. Breyer, J. P. (Centre de Recherches Metallurgique, Liege); Diez, J. M.; Leroy, V.; Habraken, L.; Huet, J. J. Met. Rep. CRM (Cent. Rech. Met., Brussels); No. 36, 67-75(1973).

Recent experimental results tend to indicate that embrittlement and swelling due to irradiation by fast neutrons are not so important in ferritic as in austenitic stainless steels. For this reason, it would be possible to use ferritic steels as canning or structural materials in fast reactors. In a joint program it was decided to develop a ferritic alloy, strengthened by inert phase dispersion, to be compatible with a sodium environment. This work is concerned with the results pertaining to the metallic matrix of this material. It is shown that titanium and molybdenum are interesting additions to the Fe–13 Cr ferritic alloy as far as the mechanical properties at high temperature are concerned. Creep rupture strength and low cycle behavior of these ferritic alloys have been measured in the temperature range from 600 to 750°C. (auth)

10724 CRYSTAL STRUCTURE AND LATTICE CONSTANTS OF RE_3Pd_4, Y_3Pd_4, AND Th_3Pd_4 COMPOUNDS. Palenzona, A.; Iandelli, A. (Univ., Genoa). J. Less-Common Metals; 34: 121-124(1974).

Alloys of the rare earths (R.E.), yttrium, thorium, hafnium, and uranium with palladium of the M_3Pd_4 composition were studied. For this composition, with the exception of Eu, U, and Hf, single phases are formed, crystallizing with the Pu_3Pd_4-type of structure. The stability of these compounds appears to be restricted to the radius ratio (R_M/R_{Pd}) range between 1.20 and 1.37. (auth)

10725 UNIDIRECTIONAL SOLIDIFICATION OF THE PSEUDO-BINARY EUTECTIC COPPER/E PHASE. Sprenger, H.; Nickl, J. J. J. Less-Common Metals; 34: 73-89(1974). (In German).

During the investigation of the ternary systems {Ti, Zr, Hf}–Cu–Si, pseudobinary sections with eutectics copper/E phase were found. The system Cu/ZrCuSi has a volume fraction of 9.5% ZrCuSi and a eutectic temperature of 1045°C. Unidirectional solidification of Cu/ZrCuSi alloys produces a two-phase composite material with ZrCuSi fibers in a Cu matrix. The fibers are arranged parallel to the growth direction. The crystallographic relationship between matrix and fibers may be described as $[001]_{Cu} \| [001]_{ZrCuSi} \|$ growth direction and $(110)_{Cu} \| (1\bar{1}0)_{ZrCuSi}$. The high electrical and thermal conductivity of the eutectic is due to the extremely low solubility of Zr and Si in the copper matrix. The mechanical strength and oxidation resistance of the eutectic show a reasonable increase over the properties of pure copper. (13 figures) (auth)

10726 TERNARY SYSTEM (Ti, Zr, Hf)–Cu–Si. Sprenger, H. (Univ., Munich). J. Less-Common Metals; 34: 39-71(1974). (In German).

The investigation of the systems {Ti, Zr, Hf}–Cu–Si revealed the existence of several new ternary phases. Besides the earlier-described E phases TiCuSi, ZrCuSi, and HfCuSi and the Fe_2P-type phases $Zr_3Cu_4Si_2$ and $Hf_3Cu_4Si_2$, the new phases $Zr_3Cu_4Si_4$ and $Hf_3Cu_4Si_4$ ($Gd_3Cu_4Ge_4$-type) and the $TiAl_3$-related compounds Zr_2CuSi_4, $ZrCuSi_2$, $Zr_3Cu_3Si_4$, Hf_2CuSi_4, and $HfCuSi_2$ were found. Isothermal sections of the ternary phase diagrams were deter-

mined at a temperature of 800°C. The geometric principles of the structures are similar to the related phases appearing in the homologous systems (with Fe, Co, Ni, Al replacing Cu). The investigation of the conditions for the existence of the ternary phases shows that the predominant factor is the variation of the valence electron concentration by the mutual replacement of Si by Cu atoms and vice versa. (10 tables, 5 figures, 79 references) (auth)

10727 MAGNETIC DISORDER RESISTIVITIES OF HEAVY RARE EARTH ALLOYS. Arnold, P. G.; Popplewell, J. (Univ. of North Wales, Bangor). J. Phys., F (London); 3: No. 11, 1985-1993(Nov 1973).

Magnetic disorder resistivities were measured for polycrystalline gadolinium, dysprosium, and erbium alloys with yttrium. Results are interpreted using Dekker's (J. Appl. Phys.; 36: 906-12 (1965)) model which gives an effective mass ratio α for the Gd-Y alloy system which is concentration independent at 2.6 ± 0.2. The exchange coupling constant J for the Gd-Y alloy system is concentration dependent and varies from 2.9 ± 0.1 eV Å^3 to 3.3 ± 0.1 eV Å^3 for alloys containing less than 35% Gd. The corresponding values of α for the dysprosium and erbium alloys are 3.7 ± 0.2 and 4.1 ± 0.2. The value of J does not vary significantly within experimental error for the concentrated Dy-Y and Er-Y alloys, the value being 2.6 ± 0.1 eV Å^3 and 2.1 ± 0.1 eV Å^3 respectively. Differences in the observed and calculated Nordheim coefficients are also discussed. (auth)

10728 PRESSURE AND TEMPERATURE FORMATION OF A_3B COMPOUNDS. II. Nb_3Ge, Nb_3Sn, Nb_3Pb, V-In AND V-Pb. Leger, J. M. (CNRS, Bellevue, France); Hall, H. T. J. Less-Common Metals; 34: 17-24(1974).

The formation of the compounds Nb_3Ge, Nb_3Sn, Nb_3Pb was investigated under high pressures and temperatures (20-70 kbar, 800-2200°C). A new fcc phase of Nb_3Sn was synthesized; two cubic structures were obtained from the reaction of niobium with lead and new structures for compounds of vanadium with lead or indium are also reported. The appearance of the A15 structure is discussed in terms of the ratios of the atomic radii of the elements and it is concluded that pressure helps its formation when the ratio r_A/r_B is smaller than a critical value. (auth)

10729 RATE OF EVAPORATION OF RARE-EARTH METALS OF THE CERIUM GROUP FROM IRIDIUM ALLOYS. Rozhkov, S. E.; Kultashev, O. K.; Vasil'eva, T. I. Tr. Inst. Fiz. Metal. Ural. Nauch. Tsent., Akad. Nauk SSSR; No. 28, 246-249(1971). (In Russian).

Evaporation of rare-earth metals from Ir alloys was measured by the deposition rate on to a W strip and from the quantity of the rare-earth metal lost from the alloy after prolonged treatment. The systems considered, i.e., Ir with La, Ce, Pr, and Sm, are two-phase systems in which one phase is purer Ir and the other an intermetallic rich in the second metal, e.g., $MeIr_2$, $MeIr_5$. Ir-Ce and Ir-Sm alloys have the least and greatest evaporation rates, respectively. The heat of activation for rare-earth metal vaporization from these Ir alloys falls from 6.7 eV for Ce to 5.2 eV for Sm. (Metals Abstr.)

10730 CONDUCTIVITY MECHANISM OF β-RHOMBOHEDRAL BORON IN A STRONG ELECTRIC FIELD. Berezin, A. A.; Golikova, O. A.; Kazanin, M. M.; Tkalenko, E. N.; Zaitsev, V. K. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (a); 20: No. 2, 447-458(16 Dec 1973).

The dependence of electric conductivity of pure β-rhombohedral boron on temperature and electric field intensity is presented. Results are discussed using three models: (I) the Poole-Frenkel model for an isolated trapping center and for a screened Coulomb center, (II) the hopping models of Mott and Shklovskii, and (III) the small polaron model. Results of electric field measurements may be satisfactorily interpreted in both the screened Poole-Frenkel and the hopping model giving for the dependence of the conductivity σ on the electric field intensity E the relations $(\sigma/\sigma_0)^{1/2}$ ln $(\sigma/\sigma_0) \sim E$ and ln $(\sigma/\sigma_0) \sim E^{-1/4}$, respectively ($\sigma_0$ is the conductivity in zero field). The model III alone gives an unreasonable result for the hopping length but nevertheless the essentiality of polaronic effect for β-boron seems sufficient from both the experimental and the theoretical point of view. It is supposed that the very complex crystal lattice of β-rhombohedral boron has a mixed conductivity of a polaron-Mott type. The magnetoconductivity of boron in the hopping region is also discussed. (auth)

10731 WEIGHT LOSS OF RHODIUM, RUTHENIUM, TUNGSTEN, AND THEIR ALLOYS AT 1800 AND 2000°C. Rytvin, E. I.; Malashkin, V. V. Tr. Inst. Fiz. Metal. Ural. Nauch. Tsent., Akad. Nauk SSSR; No. 28, 250-253(1971). (In Russian).

A gravimetric method was used to study the evaporation rate of W, Ru, W-50% Ru, and W-50% Rh at 2000°C and Rh at 1800°C in Ar, air, or vacuum. Minimum weight loss occurred in Ar for all the materials; the evaporation rate increased on heating in a vacuum; in air, the evaporation rate for Ru was an order higher and that of Rh an order lower than in a vacuum. A difference in evaporation mechanisms is proposed for the different media and the possibility of volatile oxides being present is discussed. (Ref. Zh.)

10732 THERMAL EXPANSION OF SAMARIUM, NEODYMIUM, AND PRASEODYMIUM IN TEMPERATURE RANGE 2 TO 50°K. Bulatov, A. S.; Petrenko, N. S. (Kharkov State Univ.). Phys. Status Solidi (b); 60: No. 2, K91-K94(1 Dec 1973).

The complex antiferromagnetic orderings of spin were studied by means of thermal expansion measurements. Results show that the cooperative magnetic phenomena in Sm, Nd, and Pr are followed by the appearance of negative anomalies in the thermal expansion coefficient. (DLC)

10733 ANOMALY OF THE THERMAL EXPANSION OF HOLMIUM NEAR THE CURIE TEMPERATURE. Petrenko, N. S.; Popov, V. P. (Kharkov State Univ.). Phys. Status Solidi (b); 60: No. 2, K87-K89(1 Dec 1973).

The thermal expansion of Ho in the magnetically ordered state was measured at 2 to 300°K. In the paramagnetic region (>132°K), the thermal expansion curve has a slope smaller than in the antiferromagnetic region (20 to 132°K), and the phase transition at 132°K is of the second order. Hysteresis in the measurements around 19°K indicates that this antiferroelectric-ferroelectric phase transition is of the first order. (DLC)

10734 NUCLEAR SPIN RELAXATION IN LIQUID In-Sn ALLOYS. Cartledge, G.; Havill, R. L.; Titman, J. M. (Univ. of Sheffield, Eng.). Phys. Status Solidi (a); 20: No. 2, K131-K133 (16 Dec 1973).

The longitudinal nuclear spin relaxation rate of ^{115}In in liquid In-20 and 47 at. % Sn alloys was studied at 390 to 500°K. Results show that Sn additions produce only a small effect compared with heavier atoms (sixth period), indicating that the valence difference plays a less important role in the quadrupolar relaxation than atomic size. (DLC)

10735 OPTICAL ABSORPTION IN VACUUM-EVAPORATED YTTERBIUM FILMS. Chander, R.; Kumar, R. (Solid State Physics Lab., Delhi). Phys. Status Solidi (a); 20: No. 2, 739-744(16 Dec 1973).

The peak position of one of the four observed optical absorption bands depends upon film thickness; it increases from 375 nm for a 50-Å thick film to 420 nm for a 400-Å thick film and then remains at 420 nm for thicker films (the maximum thickness studied is 600 Å). The electron micrographic investigations reveal a granular type structure of the films. The anomalous absorption in this band is due to the increase in the grain size with film thickness and can be explained on the basis of the Maxwell-Garnet theory. The peak positions of the other three absorption bands are 150, 220, and 700 nm and are independent of the film thickness. The observed peaks appear to be due to the interband transitions and the results are discussed in terms of the band theoretical calculations of Johansen and Mackintosh (1970). (auth)

10736 ION-ION POTENTIALS IN LIQUID METALS. Edwards, D. J. III. Washington, DC; American Univ. (1973). 151p. University Microfilms Order No. 73-28,812.

Thesis (Ph. D.).

The optimized model potential developed by Shaw is used to calculate the effective interaction between ions for seven simple liquid metals (Li, Na, K, Al, Mg, In, Cd). Shaw's approximation for electron exchange and correlation corrections is included in the calculation for all seven metals. The approximations for electron exchange and correlation effects proposed by Singwi et al. and Geldart and Taylor are included for Na, Al, and In for comparison. The entropy and specific heat at constant volume are calculated for all the metals, including all three approximations for many-electron effects, using the ion-ion potential and the variational formulation of the perturbation theory of liquids. Results are compared with experimental data and discussed. (Diss. Abstr. Int., B)

10737 METAL-METAL LAMINAR COMPOSITES FOR HIGH-TEMPERATURE APPLICATIONS. Hoffman, C. A.; Weeton, J. W. (Lewis Research Center, Cleveland). pp 415-453 of Failure Modes in Composites. New York; Metallurgical Society of AIME (1973).

From proceedings of the symposium on failure modes in composites; Boston, MA (8 May 1972).

A study was conducted of the potential of laminar metal-metal composites for elevated-temperature use. Most of the composites consisted of multiple layers or laminae of tungsten alternated with laminae of Nichrome V, a ductile, weaker, but oxidation-resistant alloy. Composites with 50 vol % of each phase made from 0.0025-cm, 0.0125-cm, or 0.050-cm laminae, were tested in tension and stress rupture at temperatures of 871 and 1093°C and in

impact at 23 and 524°C. A tension and a short-time stress-rupture test was conducted on specimens of 77 vol.% W-Re-Hf-C/23 vol.% Inconel Alloy 600 at 1093°C. (auth)

10738 EFFECTIVE ION-ION POTENTIAL FOR LIQUID SODIUM FROM X-RAY-DIFFRACTION DATA. Callaway, T. O. Fayetteville, AR; Univ. of Arkansas (1973). 160p. University Microfilms Order No. 73-27,462.

Thesis (Ph. D.).

X-ray-diffraction patterns were obtained for liquid sodium at 110, 180, and 250°C using transmission geometry. The resulting static structure factors were used to determine the radial distribution functions and effective ion-ion potentials directly. The radial distribution functions gave a mean separation of nearest neighbors of 3.83, 3.85, and 3.87 Å at 110, 180, and 250°C, respectively. The mean number of nearest neighbors was found to be 9.93, 9.44, and 9.16 in order of increasing temperature. Minimums in the potential functions were found to be 0.0125, 0.0114, and 0.0121 eV for 110, 180, and 250°C respectively. The effective ion-ion potentials did not possess long-range oscillatory behavior, but did possess a positive maximum before approaching zero. The lack of long-range oscillations indicates that the blurring of the Fermi surface may be as high as 10%. (Diss. Abstr. Int., B)

Radiation Effects

Refer also to abstracts 10048, 10094, 10801, 11769, 11858, 11874, and 12006.

10739 (AERE-R-6284) GROWTH AND STABILITY OF VOIDS IN IRRADIATED METALS. Bullough, R.; Eyre, B. L.; Perrin, R. C. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Dec 1969. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

A model is presented to describe the kinetics of void growth in metals during irradiation that explicitly includes the presence of both migrating interstitials and vacancies. It is clear that void growth can only occur when an excess flux of vacancies arrives at the void surface, and this can be achieved by taking into account the preferred drift of the interstitials to the dislocation sinks as a result of the long-range size-effect interaction. Results of numerical calculations of the vacancy and interstitial average concentration in stainless steel and molybdenum irradiated under typical fast reactor conditions are presented, and these are used to calculate void growth rates as a function of temperature. It is shown that the void growth rate goes through a maximum when plotted against temperature, and this is consistent with the experimental swelling data. During the early stages of irradiation, when the number of point defects arriving at voids is negligible compared with those being lost at other sinks, the swelling rate is proportional to $(t)^3$ (t = time), but at longer times when the voids are absorbing a significant number of point defects, the swelling rate decays to a linear relationship with time. Cold work has a beneficial effect in the early stages of irradiation by reducing the void growth rates, but it could have a deleterious effect over a long term by prolonging the period over which the swelling follows the more rapid $(t)^3$ law. (auth)

10740 (BNWL-tr-100) MODEL FOR THE GROWTH OF CAVITIES UNDER IRRADIATION. Gomolinski, M.; Brebec, G. Translated by L. Appleby from J. Nucl. Mater.; 43: 59-71(1972). 30p. Dep. NTIS $3.50.

A quasi chemical model has been worked out to account for the swelling of irradiated materials. This model resembling in principle that of Harkness and Che Yu Li differs from the latter in the following ways: an empirical nucleation law for cavities and loops is used, the critical radius of the nucleus is calculated more realistically by taking into account the interstitials, the calculation of the void size distribution curves is improved, and finally the equilibrium vacancy concentration near the sinks is considered. Calculated values of swelling were compared with experimental results in Al, Mg, and Cu. The influence of various parameters such as temperature, dose rate, dose, and cold work was investigated in Al. The swelling was quite well described by this model but the calculated void size distribution curves were very different from the experimental observations mainly at high temperature. The disagreement may be due to coalescence. (auth)

10741 (CEA-CONF-2267) EFFECTIVE CROSS SECTIONS FOR THE CREATION OF DAMAGES. Lott, M.; Genthon, J. P.; Gervaise, F.; Mass, P.; Mougniot, J. C.; Van Doan, N. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 6 Mar 1973. 35p. (In French). (CONF-730302-15). Dep. NTIS (U.S. Sales Only) $3.75.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

Differential cross sections were established for the calculation of the energy given up to the material in the form of elastic collisions and the number of displacements per atom. The data necessary for the calculation of these functions of damage are: (1) the elastic and inelastic neutron cross sections with their angular distributions which permit the calculation of the spectrum of recoil atoms (primary) associated with neutron collision; and (2) the energy given up and the number of atoms displaced by this primary atom and these are calculated by means of the Lindhardt universal curve in which the results are compared with those of a collision-by-collision calculation of the displacement jet. Different calculation codes adapted to the neutron spectra of thermal and fast reactors treat these data in order to calculate the energy given up to the lattice and the number of displacements per atom. These codes are coupled with different cross section libraries. The results are given in some cases of common metals and steel. The cross sections necessary for the calculation of the creation rate of gases (H and He) in irradiated metals (Al, Zn, Fe, Cu, Mo, W, Cr, Ni, Si) are reviewed. (tr-auth)

10742 (CEA-CONF-2424) MECHANICAL PROPERTIES OF THE HEXAGONAL TUBES AND JACKETS OF RAPSODIE. Swelling of the Steel of the Hexagonal Tubes of Rapsodie. Dupouy, J. M.; Erler, J.; Allegraud, G.; Bisson, A.; Blanchard, P.; Vouillon, M.; Sagot, J. P.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91, Gif-sur-Yvette (France)). [nd]. 29p. (In French). (CONF-730726-10). Dep. NTIS (U.S. Sales Only) $3.50.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

The evolution under irradiation of the mechanical characteristics of 316 steel in the cold-worked and hypertempered states was examined. The hypertempered material was sampled on jacket fragments irradiated at 410 to 620°C. Hardening and a very high loss of ductility were observed. The principal difficulty consists in separating the neutron-irradiation effects from those due to the presence of the fuel. The cold-worked material was sampled on hexagonal tubes of Rapsodie irradiated between 410 and 480°C. At low temperature a hardening of the steel was observed, whereas between 440 and 470°C a decrease of the elasticity limit followed by an increase when the dose increases was observed. At high doses the elasticity limit seems to attain a level independent of the initial state. The swelling was studied on hexagonal tubes by electron microscopy and by density measurements. It was shown that the mean number and volume of cavities depend in a very different manner on the flux and the time. Density measurements showed that the maximum swelling is produced by a value to the maximum flux and at a temperature of 435 to 440°C. A swelling law was established as a function of the maximum flux, time, and temperature. An in-pile creep experiment at temperatures below 500°C showed that the cold-worked steel creeps in-pile with a rate almost proportional to the flux and to the stress. The hypertempered steel practically does not creep. In the temperature region studied the stress has no effect on the swelling. (tr-auth)

10743 (CONF-720613-P2, pp 747-764) RADIATION AND THERMAL EFFECTS ON STRUCTURAL STABILITY AND PHYSICO-MECHANICAL PROPERTIES OF Mo AND W. Kuznetsov, V. A.; Bykov, V. N.; Zakharova, M. I.; Zasorin, I. P.; Kuvshinov, S. N. (Inst. of Physics and Power Engineering, Obninsk, USSR). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

High-temperature annealings up to 2500°C were conducted for single crystals of Mo and W before and after BR-5 reactor irradiation at an nvt of $1.4 \times 10^{22} n/cm^2 (4 \times 10^{21} n/cm^2, E > 1$ MeV) at the temperature near 450 to 500°C. It was found that polygonal processes result in structures with different angle incoherent boundaries. The intensity of the process depends on the initial structure and increases during diffusion of the other elements (Nb, Zr, U) in Mo and W. The results on the correlation of the substructure with melting method, mechanical properties, and distribution of impurities in single crystals are presented. During the irradiation the single-crystal strength increases without loss of ductility; the density and lattice parameters decrease; the resistance increases. The results of properties changes during the annealings are also reported. Properties of Mo and W irradiated by neutrons at high temperatures at the operating conditions of the TIC cathodes (TIC-thermionic converter) were investigated. The nature and thermal stability of radiation-induced defects that lead to the properties change under irradiation were studied. The thermal and radiation stabilities of refractory metals are discussed on the basis of the experimental and theoretical data. (auth)

10744 (HEDL-TME-73-85) DAMAGE FUNCTION ANALYSIS OF NEUTRON-INDUCED MECHANICAL PROPERTY CHANGE DATA IN TYPE 304 STAINLESS STEEL. Simons, R. L.; McElroy, W. N.; Blackburn, L. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 63p. AT.

Damage functions were determined for Type 304 stainless steel mechanical property changes in yield strength, total elongation, uniform elongation, and ultimate tensile strength for an irradiation and test temperature of ~480°C. The damage functions provide improved correlation of mechanical-properties change data by considering the effect of differences in test-reactor neutron spectra. Damage functions are used in predicting fluence limits for specified property level changes for reactor design studies. By propagating errors in the damage function analysis, a conservative lower bound fluence limit may be estimated. Results show that the yield strength damage function is nearly the same as the displacement cross section used as the first approximation to the damage function. The total elongation damage function shows a high-energy, >4-MeV, and low-energy, $<10^{-3}$-MeV, enhancement of damage. Consequently, it is necessary to consider neutrons of all energies when correlating both fast and thermal test reactor data. (auth)

10745 (WAPD-TM-1106) EFFECTS OF NEUTRON IRRADIATION ON THE FRACTURE PROPERTIES OF A302B PRESSURE VESSEL STEEL WELDMENTS. Hall, J. F.; Seman, D. J. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Jul 1973. Contract AT-11-1-GEN-14. 49p. Dep. NTIS $4.50.

The effects of neutron irradiation on the fracture properties of the base metal, weld metal, and weld heat-affected zone (HAZ) metals of three commercially produced A302B weldments were studied. Irradiation effects were determined by measuring the shifts in the 30 ft-lb transition temperatures and the fracture mechanics (50 ksi $\sqrt{\text{in}}$) transition temperatures caused by irradiation. Superior toughness in both nonirradiated and irradiated conditions were observed for weld metals and HAZ as compared with base metals. Less-sensitive response to irradiation was observed for the weld metals, as compared with the base metals, but conflicting results were obtained for HAZ materials. (auth)

10746 FUNDAMENTALS OF RADIATION EFFECTS TESTING. Sinclair, E. E.; Simmons, J. M.; Zwilsky, K. M. (Atomic Energy Commission, Washington, DC). pp 198-228 of Testing for Prediction of Material Performance in Structures and Components. Philadelphia; American Society for Testing and Materials (Oct 1972).

From symposium on testing for prediction of material performance in structures and components; Anaheim, California, USA (21 Apr 1971). See CONF-710470-P1.

The basic effects of irradiation, such as transmutation reactions, hardening, void formation, and high-temperature embrittlement in reactor materials are reviewed. Testing for these effects takes the form of pre-post testing as well as in-reactor observations. Pre-post testing consists of measuring a property out-of-reactor and measuring the same property after the material has been exposed to the neutron environment. Although changes in properties of a material can be determined before and after irradiation, the influence of a neutron flux on rate processes such as creep must be determined in-pile. Characterization of the reactor environment, including neutron dosimetry and temperature measurements are discussed, and examples of predictive testing of materials for reactor fuels, cladding, components, and pressure vessels are reviewed. (20 figures, 50 references) (auth)

10747 VOID VOLUME SWELLING DEPENDENT ON GRAIN SIZE IN AN AUSTENITIC STAINLESS STEEL. Singh, B. N. (Danish Atomic Energy Commission, Risoe). Nature (London) Phys. Sci.; 244: No. 139, 142(27 Aug 1973).

It is stated that since grain boundaries act as neutral and unsaturable sinks for vacancies and self-interstitials in metals, grain refinement is expected to reduce void volume swelling, and a description is given of some of the main findings in a systematic study of the effect of grain size on void volume swelling. Powder-produced ^{29}Ni/^{20}Cr austenitic stainless steel, with 0.02% C and without carbide-forming elements, was used in the irradiation studies. Some specimens containing dispersions of Al_2O_3 particles were also irradiated. High-energy electron irradiation was used to study the formation and growth of voids, and all irradiation experiments were made at 600°C in the EM-7 1-MeV electron microscope at Harwell. Before irradiation 10 ppm of He was injected into the samples, using a 100 MeV heavy ion accelerator. A detailed analysis of the results showed that void concentration and void volume swelling are significantly reduced by decreasing the grain size. Similar results were obtained for specimens without implanted He. It was also found that void volume swelling for a given grain size and at a given dose level is smaller in samples containing oxide particle dispersions. (UK)

10748 EFFECTS OF ATOMIC DISPLACEMENTS IN GUINIER-PRESTON ZONE OF Al-Zn ALLOY ON CHANNELING OF PROTONS. Sakurai, T. (Kyoto Univ.). J. Phys. Soc. Jap.; 35: No. 1, 113-119(Jul 1973).

The atomic displacements in the spherical G-P zones precipitated in an Al-Zn single crystal are studied by analyzing the backscattered energy spectra of high-energy protons. The analysis is carried out on the basis of the displaced-atom model proposed by Merz and Gerold. Direct-scattering results show that the values of distortion constants are 0.64×10^{-2} and 1.27×10^{-2} for the G-P zones with radius 40 Å and 20 Å, respectively. (auth)

10749 DISPLACEMENT CROSS SECTIONS FOR IRON, CHROMIUM, NICKEL, STAINLESS STEEL, AND TANTALUM. Doran, D. G. (Hanford Engineering Development Lab., Richland, WA). Nucl. Sci. Eng.; 52: No. 3, 398-402(Nov 1973).

The effects of some recent developments on displacement cross sections published by the author for iron, chromium, nickel, 18/10 stainless steel, and tantalum are discussed. It is argued that, except for tantalum, the cross sections are essentially consistent with ENDF/B-III, and furthermore, can be made consistent with an IAEA-recommended secondary displacement model by multiplying by 0.66. A redetermination of the tantalum displacement cross section was made using ENDF/B-III data and an effective displacement energy of 90 eV deduced from a recent measurement of the displacement threshold surface for tantalum. Estimates are made of the contributions to displacement cross sections of several previously ignored nonelastic processes. Finally, the usefulness of the isotropic elastic-scattering approximation at high neutron energies is discussed. (auth)

10750 HIGH YIELD STRENGTH STEELS FOR NUCLEAR REACTORS. Rousseau, P. Ind. At. Spatiales; 17: No. 3, 27-42 (May 1973). (In French).

The type of steel used in the construction of nuclear reactor vessels varies widely, depending upon the type of reactor involved. For most common reactors (PWR or BWR types), the basic steel used was, for a long time, grade A302gr B with MnMo. In order to obtain an enhanced resistance to nicking, Ni was added to the steel, and a grade A 533gr B and C steel with Mn-Ni-Mo was developed. The thickness of the steel involved necessitated special precautions in its development and manufacture. These products must have a high resistance to rupture due to irradiation embrittlement as well as to classical embrittlement rupture. The welding of very thick parts poses special problems which necessitate careful attention during the welding process and during after-welding treatment. (FR)

10751 EFFECT OF FAST-NEUTRON IRRADIATION ON Zr_4Al_3. Wilson, C. G.; Wilson, N.; Joksimovic, V.; Westphalen, J. A. (South Australian Inst. of Tech., Adelaide). Acta Crystallogr., Sect. A; 29: No. 4, 336-341(1 Jul 1973).

The effect of fast-neutron radiation on the structure of Zr_4Al_3 was studied using X-ray diffractometry. The changes in line intensity are explained by the disordering caused by the replacement of 0.5 atom in zirconium sites by aluminum. The anisotropic changes in the size of the unit cell can be partially explained by the geometrical changes produced by the disordering of atoms of unequal size. (auth)

10752 DISLOCATION PINNING IN ELECTRON-IRRADIATED COPPER AS A FUNCTION OF ELECTRON ENERGY AND IRRADIATION. Roth, G. (Kernforschungsanlage, Juelich, Ger.); Wollenberger, H.; Zeckau, C.; Luecke, K. (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Dislocation priming measurements were performed in the kHz range in ASARCO copper. The samples and irradiation facilities are constructed so as to allow successive irradiation of samples both with electrons and γ rays. The γ rays were produced by stopping 2.8-MeV electrons in a gold target. The change of the type of irradiation could be achieved without any handling of the sample. Thus it is possible to detect rather small differences between the two types of irradiation. Recovery experiments at 400°K after 78°K irradiation and pinning rates during irradiation at 400°K and 78°K were made. (GE)

10753 DISLOCATION PINNING OF MOLYBDENUM AFTER LOW-TEMPERATURE NEUTRON IRRADIATION. Okuda, S.; Mizubayashi, H. (Japan Atomic Energy Research Inst., Tokai). (1973). vp.

From 5th international conference on internal friction and ultrasonic attenuation in crystalline solids; Aachen, Germany (27 Aug 1973).

Dislocation pinning by the stage I defects in Mo single crystals was studied after fast neutron irradiation at liquid helium temperature by means of internal friction and dynamic modulus measurements during warmup. (GE)

10754 EFFECTS OF THERMAL-NEUTRON IRRADIATION IN ELEMENTAL BORON. Born, E. (Technische Univ., Munich). (1973). vp. (In German).

From 14th discussion meeting of the Arbeitsgemeinschaft Kristallographie of the Deutsche Mineralogische Gesellschaft, of the Deutsche Physikalische Gesellscha?t and of the Gesellschaft Deutscher Chemiker; Frank am Main, Germany (4 Oct 1973).

Various model calculations for determining the concentration of He and Li (from the reaction $^{10}B(n,\alpha)^{7}Li$) are discussed. These calculations consider in particular, the attenuation of the neutron current penetrating the boron sample at right angles to the sample surface. The experimental verification of the diffusion of Li is carried out by means of etching and polishing and subsequent flame photometric determination of Li, whereas the determination of He is done by gas chromatography. The total irradiation damage (due to neutron and gamma rays in the reactor) is analyzed in the scanning electron microscope and visualized by radiographs (of boron crystals or boron wires). (GE)

10755 INFLUENCE OF INTERSTITIAL IMPURITIES ON DEFECT PRODUCTION AND RECOVERY IN NIOBIUM NEUTRON-IRRADIATED AT 4.6 K. Vavra, F.; Doenitz, W.; Boening, K. (Technische Univ., Munich). Phys. Status Solidi (a); 20: No. 2, 511-519(16 Dec 1973).

Pure niobium and niobium doped with 1700 ppM nitrogen and with 3900 and 4200 ppM oxygen were irradiated at 4.6 to 7°K in the reactor up to a neutron dose of 3×10^{18} cm^{-2}. The measured increase of max. 15.3% in the damage production rate of the doped samples is mainly due to the reduction of radiation-annealing processes because of trapping reactions at the foreign atoms. The strong suppression of the recovery in the doped samples up to about 28°K is also explained by trapping reactions of the self-interstitials which already have to cover rather large distances. The recovery behavior is influenced by the foreign atoms in the whole measuring range up to 354°K and can be interpreted in terms of well-known recovery models for fcc metals. (auth)

10756 INFLUENCE OF SMALL AMOUNTS OF NITROGEN AND CARBON ON THE MAGNETIC AFTER-EFFECT IN NEUTRON-IRRADIATED IRON. II. High-Temperature Relaxation. Blythe, H. J. (Univ. of Sheffield, Eng.). Phys. Status Solidi (a); 20: No. 2, 619-628(16 Dec 1973).

The magnetic after-effect, observed as a time decrease of the initial susceptibility, was measured in the temperature range 20 to 250°C in neutron-irradiated iron specimens containing small controlled amounts of nitrogen and carbon; the temperature of irradiation was 45°C and the integrated dose 9.8×10^{18} n cm^{-2}. Between 0 and 200°C, a complex relaxation spectrum is observed whose amplitude increases rapidly with carbon and nitrogen concentration. The relaxation partly anneals out during the course of measurements and this is attributed to the migration of impurity–vacancy pairs. The remaining relaxation, which anneals out in the range 220 to 350°C, is attributed to the reorientation of complex impurity–vacancy agglomerates. (12 figures) (auth)

Other Materials

Refer also to abstracts 9763, 9833, 9836, 9924–9930, 10038, 10640, 10668, 10711, 10760, 11689, 11821, 12454, 12479, and 12486.

10757 (CEA-CONF-2239) FIRST RESULTS OBTAINED AT LETI IN TRANSMISSION ELECTRON MICROSCOPY ON THE DEFECTS CREATED BY IONIC IMPLANTATION OF ^{31}P IN SILICON (111) AND THEIR BEHAVIOR IN THE COURSE OF SEVERAL ANNEALINGS. Truche, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 24p. (In French). (CONF-720990-7). Dep. NTIS (U.S. Sales Only) $3.25.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

^{31}P was implanted at 30 keV in Si (III) at a dose of 10^{16} atoms/cm^2. The implanted Si samples were annealed at 500° for 4 h, 650° for 4 h, 750° for 4 h, or 850° for 5 min. The behavior of the implanted ^{31}P as a result of the anneal was followed by transmission electron microscopy. The principles of the electron microscopy technique used were reported. After annealing at 500°, the first agglomerates of defects were formed in the substrate. After annealing at 650°, epitaxial recrystallization occurred. The interstitial ions were united to form dislocation rings which attained their average size (200 Å). After annealing at 750° for 4 h or 850° for 5 min, the dislocation rings were stabilized and the vacancies near the surface formed dislocation dipoles. After annealing at 850° for 4 h, the interstitial ions, as a result of a strong migration of the vacancies, were located in substitutional sites in the lattice. The residual vacancies were assembled in the form of a dislocation dipole lattice near the surface. (JSR)

10758 (CEA-CONF-2245) CHARACTERIZATION OF PROFILES IMPLANTED IN MULTILAYERS BY MEANS OF THE CASTAING-SLODZIAN ANALYZER. Bernard, J.; Combasson, J. L.; Hillaret, N. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 3 Nov 1972. 15p. (In French). (CONF-720990-8). Dep. NTIS (U.S. Sales Only) $3.00.

From conference on the physico-chemical and electrical characteristics of the material and the manufacturing procedures in the field of semiconductors; Grenoble, France (27 Sep 1972).

Distribution profiles of B implanted in SiO_2/Si, Si_3N_4/Si, and $Si_3N_4/SiO_2/Si$ were obtained by means of the Castaing–Slodzian analyzer. The nonannealed samples were implanted at various energies and at doses from 10^{14} to 5×10^{15} ions/cm^2. The profiles show that the shape differs significantly from the gaussian distribution predicted by the simplified theory. A concentration discontinuity is observed at the passage of the interface Si_3N_4/SiO_2 or SiO_2/Si. The precision and reproducibility of the profiles are an efficient aid in the development of a mathematical penetration model in an amorphous target. (JSR)

10759 MULTIPLE SCATTERING AND PLANAR DECHANNELING IN SILICON AND GERMANIUM. Feldman, L. C. (Bell Telephone Labs., Murray Hill, NJ); Appleton, B. R. Phys. Rev., B; 8: No. 3, 935-951(1 Aug 1973).

The dechanneling of MeV protons from the planar channels of silicon and germanium is investigated. The backscattering technique and transmission technique for measuring the dechanneling rate are compared and show good agreement. The data are treated in the framework of a diffusion model which describes the observed energy dependence of the dechanneling length. Various physical mechanisms which contribute to the diffusion are discussed and estimated. Direct measurements of the multiple scattering in the channels are compared to estimates of the diffusion constants. (17 figures) (auth)

10760 NUCLEAR-GRADE CONCRETE SURFACERS AND COATINGS. Lopata, J. R. Power Eng.; 77: No. 12, 38-39(Dec 1973).

Coatings inside class-one structures require stringent qualifications. Coatings must be readily decontaminated from radiation, resist degradation from radiation, and provide adequate protection to the substrate from physical and chemical abuse for long periods. A sophisticated coating system applied to irregular, porous, concrete surfaces must result in a smooth, even, void-free finish to be acceptable for nuclear installations. The ability of a coating to remain intact under extreme accident conditions may be studied from a specific reactor's loss-of-coolant accident criteria. Thick film, thin film, and paint systems for concrete coatings are evaluated. (MCW)

10761 ESR STUDY OF U_2 CENTRES IN BaClF. Yuste, M. (Univ., Paris); Jumeau, D.; Taurel, L.; Rahmani, M.; Badoz, J. J. Phys., C (London); 6: No. 21, 3167-3173(30 Oct 1973).

An x irradiation, at 78 K, of a BaClF crystal containing OH^- ions leads to the formation of hydrogen atoms in interstitial sites (H_i^0 or U_2 centres) thermally stable below T ~ 100 K. The magnetic properties of the U_2 centres are compared with those observed in the case of U_1 centres in NaCl crystal. The thermal stability is studied and compared with those of the U_2 and $U_2(H_i^0)$ centres in NaCl. (auth)

10762 EFFECTS IN THE PROTON BOMBARDMENT OF NaF CRYSTALS. II. Depth Profile of Damage in Microhardness. Kubo, K. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 35: No. 1, 125-129(Jul 1973).

Proton-induced change in microhardness was measured on the cleavage plane of NaF crystals as a function of depth from the bombarded surface. The profile obtained includes maxima, one of which is possibly due to the protons stopped after penetration. The others appear to be related to either the nuclear reaction $^{19}F(p,\alpha\gamma)^{16}O$ or the strain resulting from expansion due to the atomic displacements by protons. The hardening centers are likely to be submicroscopic inclusions, probably consisting of metallic precipitates and gas bubbles as well as voids. Decrease in the microhardness beyond the range end is exponential up to about 20 μm, while the change in dislocation mobility extends as far as 100 μm beyond the range end. The form of the profile is influenced by both temperature and proton dosage. (auth)

10763 FLUIDIZED SOLID-PARTICLE FUEL. Messer, L.; Woolf, P. L. (to American Minechem Corp.). US Patent 3,775,070. 27 Nov 1973. Filed date 5 Dec 1969. 4p.

Coal fines dispersed in water are wetted by a carbonaceous liquid and the mixture agitated to cause agglomeration of the fines into pellets of reduced ash content and of a size and

hardness suitable for controlled fluidization. The pellets are injected by an airstream into a combustion chamber as a solid fuel. (Official Gazette)

10764 SOME PECULIARITIES OF GRAPHITE INTERACTION WITH REFRACTORY COMPOUNDS. Evtushok, T. M. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 10, 54-56(Oct 1973). (In Russian).

Solid-phase reaction of graphite and pyrolytic graphite with refractory compounds was investigated. The primary diffusion of carbon towards the reaction product refractory compound interface was found. In the mechanism of mass transfer through the phase interphase, the vapor phase but not the solid-phase contact was of primary significance. Reaction of graphite and refractory compounds is possible due to incongruent evaporation of the refractory compounds, resulting in the appearance of phases unstable in contact with graphite. Higher temperatures are established for the beginning of the reaction with refractory compounds in pyrolytic graphite as compared with graphite. Reaction anisotropy in pyrolytic graphite was determined in the directions perpendicular and parallel to the deposition surface. (auth)

10765 CRYSTAL STRUCTURES OF $ThCl_4$ POLYMORPHS. Mason, J. T.; Jha, M. C; Chiotti, P. (Iowa State Univ., Ames). J. Less-Common Metals; 34: 143-151(1974).

$ThCl_4$ was shown to possess two polymorphic forms. The crystal structure of the β form, stable above 405°C has been well established by Mooney and by Mucker et al. to be tetragonal with space symmetry $I4_1/amd$ and lattice parameters a = 8.486 and c = 7.465 Å. The low-temperature α form was shown to be tetragonal with space symmetry $I4_1/a$ with a = 6.408 ± 0.001 and c = 12.924 ± 0.003 Å. If the thorium atoms are located at the four-fold set (4a) with positions 0, ¼, ⅛, the chlorine atoms reside in the general 16-fold set with x = 0.353, y = 0.483, and z = 0.202. These parameters are an average of the parameters determined from single-crystal data, diffractometer powder data and Debye–Scherrer powder data. The calculated density is 4.68 g/cm³ which compares favorably with the measured value of 4.64 g/cm³. Both the α and β forms contain four $ThCl_4$ units per unit cell. In both structures, the thorium atoms are surrounded by a coordination polyhedron of eight chlorine atoms. (auth)

10766 SERPENTINITES AND PROTECTION AGAINST NUCLEAR RADIATION. Krejcir, M. (Geologicky Pruzkum, Ostrava, Czech.). Geol. Pruzkum; 15: No. 3, 68-72(Mar 1973). In Czech).

Investigations are described of several serpentinite bodies on Czechoslovak territory, aiming at the verification whether their deposits can be used in the production of concrete aggregates for the shielding against nuclear radiation. Samples were taken from individual localities to determine their mineralogical and petrographic composition and chemical composition, to perform differential thermal and thermogravimetric analyses, and to obtain informative data on their special shielding properties. Results of the analyses are tabulated. (INIS)

10767 ION IMPLANTATION IN SEMICONDUCTORS. Bertolini, G.; Cappellani, F.; Restelli, G. (European Atomic Energy Community, Ispra, Italy). Euro-Spectra; 12: No. 3, 58-72(Sep 1973).

Ion implantation is presented as a complementary technique to thermal diffusion for doping semiconductors. Its use in the field of semiconductor devices is illustrated: optical and magnetic properties; variation of refractive index; modification of thin films. Other possible applications, including simulation of the effect of high neutron fluxes on materials, are considered. (14 figures, 5 tables) (DLC)

10768 THERMOLUMINESCENCE AND ISOTHERMAL ANNEALING KINETICS OF THE F-CENTRES IN X-IRRADIATED KCl AND $KCl:KNO_3$. Mukherjee, M. L. (Indian Inst. of Tech., Kharagpur). Indian J. Phys.; 47: No. 9, 569-571(Sep 1973).

The annealing characteristics of F centers in KCl and $KCl:KNO_3$ single crystals and the accompanying glow were studied. Results support the view that no connection exists between the F-center decay and thermoluminescence. (DLC)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Refer also to abstracts 9978, 9980, 9984, 10120, 10126, 10127, 10136, 10159, 10161, 10162, and 10476.

Accountability and Safeguards

10769 (LA-UR-73-1564) PORTAL MONITOR FOR DIVERSION SAFEGUARDS. Sampson, T. E.; Fehlau, P. E.; Worth, G. M.; Henry, C. N. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 20p. (CONF-731101-45). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Two prototype doorway monitors to deter the diversion of special nuclear materials have been designed and constructed. One prototype utilizes plastic scintillators while the other contains NaI (Tl) detectors. Both prototypes utilize a unique digital, sliding interval, warning logic module. Features of these two systems are described and their sensitivity for detection of ^{235}U, ^{239}Pu, and ^{233}U are presented. (auth)

10770 ROLE OF ANALYTICAL CHEMISTRY IN INTERNATIONAL SAFEGUARDS. Frittum, H. (International Atomic Energy Agency, Vienna). Izotoptechnika; 16: No. 10, 547-560(Oct 1973). (In Hungarian).

The role of analytical chemistry in the IAEA nuclear safeguards system is discussed. (auth)

10771 PROBLEMS OF THE REALIZATION OF NUCLEAR MATERIALS SAFEGUARDS. Gupta, D. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From 1st international meeting on nuclear law; Nuclear Inter Jura 73; Karlsruhe, Ger. (11 Sep 1973).

The difficulties and problems of the control within the EC can be summarized under the following categories: (1) EURATOM control according to the Treaty of Rome and EURATOM-IAEA control according to the Non-Proliferation Treaty; (2) international and national agreements; (3) interpretation of the individual articles of the verification agreement; and (4) control execution in existing nuclear facilities, e.g., materials accounting, inventory, and materials unaccounted for—MUF. (GE)

Disposal and Storage

10772 (ARH-231(Del.)) HANFORD LOW LEVEL WASTE MANAGEMENT REEVALUATION STUDY. Sloat, R. J. (comp.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 29 Dec 1967. Contract AT(45-1)-2130. 260p. Dep. NTIS $15.00.

Alternate methods of treating and disposing of low-level radioactive wastes at Hanford are examined. The methods would drastically reduce the amount of radioactivity released to the environment. (TFD)

10773 (ARH-2384) DESIGN CRITERIA: DATA ACQUISITION SYSTEM FOR WASTE TANK LIQUID LEVEL GAUGES AND SX TANK FARM THERMOCOUPLES. Martin, G. E.; Oliver, R. G. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 17 Feb 1972. Contract AT(45-1)-2130. 12p. Dep. NTIS $3.00.

This design criteria revision (revision 2) will cancel revision 1 and will provide complete functional supervision of the liquid level gauges. A new counter and an electronic supervisory circuit will be installed in each waste tank liquid level gauge. The electronic supervisory circuit will monitor (via the new counter and a signal from the gauge electronics) cycling of the gauge on a one minute time cycle. This supervisory circuit will fulfill the intent of revision 1 (monitor AC power to the gauge) and, in addition, will supervise all other aspects of the gauge including: the electronics, the drive motor, all sprockets and chain linkages, and the counter. If a gauge failure should occur, this circuit will remove the +12 volts excitation from the data acquisition system interface board; and the computer will be programmed to recognize this condition as a gauge failure. (auth)

10774 (ARH-2419) RADIOACTIVE EFFLUENT REDUCTION FROM 200 AREA FACILITIES, PHASE II. Hanson, G. L. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 24 Mar 1972. 25p. Dep. NTIS $3.25.

Gaseous and liquid wastes released from the 200 Area from 1965 through 1971 are presented. Recommendations are given to provide facilities and/or modifications to existing facilities which will reduce the radioactivity discharged to the ground. (TFD)

10775 (ARH-2757(Pt.3)) RADIOACTIVE LIQUID WASTES DISCHARGED TO GROUND IN THE 200 AREAS DURING 1972. Anderson, J. D. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 9 Apr 1973. 141p. Dep. NTIS $9.25.

An overall summary of the radioactive liquid wastes discharged to the ground, since startup and during 1972, in the 200 Area at HAPO is presented. (TFD)

10776 (ARH-2874) 241-T-106 TANK LEAK INVESTIGATION. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2130. 48p. Dep. NTIS $4.00.

On June 8, 1973, the 241-T-106 underground liquid waste storage tank, located on the U. S. Atomic Energy Commission's Hanford reservation, was confirmed as leaking. It was predicted that the leaked waste would be retained by the dry sediments well above the water table. A study was instigated to confirm this prediction. Results show the deepest penetration observed was 27 meters below the ground surface or 35 meters above the water table (approximately 87 and 116 feet, respectively). Based on these results and the basic knowledge of liquid movement in Hanford sediments, further movement of the radioactivity from its present location will be negligible. (auth)

10777 (ARH-R-43(Rev.2)) MANAGEMENT OF RADIOACTIVE WASTES STORED IN UNDERGROUND TANKS AT HANFORD. Harvey, R. W. (comp.). (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Apr 1970. 56p. Dep. NTIS $5.00.

Past and present methods used to store radioactive waste in underground tank farms at the Hanford Plant are described. (TFD)

10778 (BNWL-CC-2617) FAILURE OF 307 BASIN TRANSFER LINE AND RESULTANT GROUND CONTAMINATION. Denham, D. H. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1970. Contract AT(45-1)-1830. 26p. Dep. NTIS $3.50.

A leak of apparently long duration was discovered on December 9, 1969, in the transfer line from the 307 retention basins to the 340 contaminated waste system during the transfer of liquid from one of the 307 basins. This line was designed to carry only mildly-contaminated retention system waste. However, the uncovered line suggests that, over a period of time, the bottom half of the carbon steel transition section between the transfer line and the 340 contaminated waste system was corroded out. This permitted the highly contaminated waste to percolate into the soil beneath the missing pipe section. Since neither the duration of leakage nor the exact origin or nature of the contaminants were known, this study was undertaken to: (1) estimate the amount of radioactivity released; (2) document its location with respect to the 340 Area and to the underlying groundwater; and (3) investigate its potential environmental impact. Soil samples were collected to determine the approximate location and quantity of each of the radionuclides which had leaked to the soil. One-digit accuracy was deemed sufficient to decide what, if any, action would be required. The findings from the several exploratory holes drilled at and adjacent to the site of the corroded transfer line are reported. (auth)

10779 (CEA-CONF-2234) RADIOPROTECTION AND MANAGEMENT OF RADIOACTIVE WASTES. Fitoussi, L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 14p. (In French). (CONF-721122-3). Dep. NTIS (U. S. Sales Only) $3.00.

From regional study group meeting on radiological and environmental protection; Istanbul, Turkey (20 Nov 1972).

A review is given of the various aspects of the management of radioactive wastes. The factors to be considered in this management are first summarized. In radioprotection from radioactive wastes the workers involved in all operational phases and the general population exposed to radiation risks created by the dispersion or storage of these wastes in the environment must be considered. It is concluded that the short term risks are negligible. (JSR)

10780 (N-73-25721) ANALYSIS OF TEMPERATURE AND PRESSURE DISTRIBUTION OF CONTAINERS FOR NUCLEAR WASTE MATERIAL DISPOSAL IN SPACE. Final Report. Van-Bibber, L. E.; Parker, W. G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1973. Contract NAS3-16819. 111p. (NASA-CR-121186). NTIS $7.75.

A computer program was adapted from a previous generation program to analyze the temperature and internal pressure response of a radioactive nuclear waste material disposal container

following impact on the earth. This program considers component melting, LiH dissociation, temperature dependent properties and pressure and container stress response. Analyses were performed for 21 cases with variations in radioactive power level, container geometry, degree of deformation of the container, degree of burial and soil properties. Results indicated that the integrity of Type 316 stainless steel containers could be maintained with partial burials of either underformed or deformed containers. Results indicated that completely buried waste containers, with power levels above 5 kW, experienced creep stress rupture failures in 4 to 12 days. (auth)

10781 (N-73-27943) EVALUATION OF SOME SPECIAL TECHNIQUES FOR NUCLEAR WASTE DISPOSAL IN SPACE. MacKay, J. S. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Aug 1973. 25p. (NASA-TM-X-62272). NTIS $3.25.

A preliminary examination is reported of several special ways for space disposal of nuclear waste material which utilize the radioactive heat in the waste to assist in the propulsion for deep space trajectories. These include use of the wastes in a thermoelectric generator (RTG) which operates an electric propulsion device and a radioisotope–thermal thruster which uses hydrogen or ammonia as the propellant. These propulsive devices are compared to the space tug and the space tug/solar electric propulsion combination for disposal of waste on a solar system escape trajectory. Such comparisons indicate that the waste-RTG approach has considerable potential provided the combined specific mass of the waste container–RTG system does not exceed approximately 150 kg/kW_e. Several exploratory numerical calculations have been made for high earth orbit and Earth escape destinations. (auth)

10782 (NP-19911) APPLICATION OF ARTICLE 37 OF THE EURATOM TREATY. Survey of Activities: Experience Gained, 1959–1972. (Commission of the European Communities, Luxembourg. Directorate for Health and Safety). 1972. 70p. Dep. NTIS (U.S. Sales Only) $5.50.

Article 37 of the Euratom Treaty stipulates that each Member State shall submit to the Commission such general data concerning any plan for the disposal of radioactive waste as will enable the Commission to give its opinion whether or not the implementation of such a plan is likely to involve radiological consequences in another Member State. In the 12 y during which this Article has been applied, the Commission has issued 57 opinions relating to 79 nuclear installations. This report, which is intended particularly to give information to the new Member States, sets out the procedure followed in formulating such opinions, the main points under consideration when a plan for disposal is examined, the experience acquired and some of the prospects for the future. (auth)

10783 POSSIBILITY OF STORING BITUMEN BLOCKS CONTAINING RADIOACTIVE WASTES IN THE SOIL. Burenkov, R. N.; Khonikevich, A. A. Gig. Sanit.; No. 9, 55-58(Sep 1973). (In Russian).

On the basis of prognosis of migration of the most dangerous radionuclides (^{90}Sr and ^{137}Cs) contained in the radioactive wastes, and taking into account radioactive properties of these nuclides and the meteorological situation, it is concluded that in certain cases the storage of bitumen blocks directly in the soil is permissible. (auth)

10784 RADIOACTIVE WASTE MANAGEMENT: A REVIEW. Prasad, V. S.; Deshpande, W. M. (Visvesvaraya Regional Coll. of Engineering, Nagpur, India). Indian J. Environ. Health; 14: No. 4, 310-327(Oct 1972).

The health hazards from ionizing radiations are discussed. The hazards, acute, chronic, and genetic are further classified by the mode of entry of ionizing radiation into the site of action as external inhalation, ingestion, and absorption. These are discussed with respect to radioactive waste disposal. The various methods of disposing solid, liquid, and airborne wastes are described. The basic principles of radioactive waste disposal are grouped as (1) dilute and disperse, (2) delay and decay, (3) concentrate and contain. The relative merits and demerits of each of the above principles are highlighted for low, intermediate, and high level wastes. Biological methods applied in the preliminary treatment of laundry wastes to avoid the use of high reagent doses and the production of large sludge volumes in subsequent chemical treatment are also considered. (INIS)

10785 SAFETY OF THE ULTIMATE STORAGE OF RADIOACTIVE WASTES IN THE ASSE SALT MINE. Neuherberg, Ger.; Sueddeutscher Verlag (1973). 48p. (In German).

The processes and techniques for the ultimate storage of radioactive wastes in the Asse salt mine have been developed and tested on a large technical scale. Intensive safety studies have been performed for the mine as well as for the storage of weak and medium active wastes. In these studies, all available data and equipment are described in detail and in particular the conceivable accidents during operation, their long-term effects as well as the recommended countermeasures are thoroughly dealt with. The present report briefly summarizes the essential results of this safety study, in which technical details are deliberately emitted. Furthermore, the research and development for the storage of highly radioactive wastes in the Asse salt mines are discussed. (GE)

10786 TEN YEARS OF CONTROLLING THE RADIOACTIVITY OF LIQUID WASTES. Ewen, K.; David, G. (Zentralstelle fuer Sicherheitstechnik, Duesseldorf, Ger.). Wasser, Luft Betr.; 17: No. 10, 366-369(1973). (In German).

By far the greatest part of registered radioactivity related to radioactive wastes comes from medical uses of radioactive isotopes in diagnostics and therapy. Nuclear chemistry and biological medical research contribute a relatively small amount. The liquid waste load through nuclear technological plants can in this case be neglected. The average contribution of the single isotopes to the total activity can be determined by spectroscopic methods, and ordered according to frequency in more or less the following order: ^{131}I, ^{74}As, ^{203}Hg, ^{197}Hg, ^{198}Au, ^{99}Mo, ^{85}Sr. Sewage purification plants as well as liquid waste channels below the inlets of radioactive materials are control positions. In sewage purification plants, foul sludge or fresh sludge samples are taken as well as daily waste liquid samples continuously collected from the inlet, whereas sampling of the liquid waste channels occurs continuously over a period of 1 to 7 days. In addition, ground samples of the sewage farms are investigated every half-a-year. (GE)

10787 PRESENT STATUS OF ALPHA RADIOACTIVE WASTES MANAGEMENT. Sakata, S.; Matsumoto, A. (Japan Atomic Energy Research Inst., Tokai). Genshiryoku Kogyo; 19: No. 1, 57-60 (Jan 1973). (In Japanese).

Wastes containing α-radioactive substances are often specially handled in waste disposal systems as "α wastes," because of exceptional hazards. Although the amount of these α wastes in Japan is presently small, it will increase in the future. In the European countries, disposal of wastes in the surface layer of the ground is carefully avoided, and they are solidified with concrete or asphalt for future ocean disposal or storage in the places of their origin. Further, efforts are being made to recover useful α-nuclides from the α wastes. The situation of the disposal of α wastes in European countries, in particular, is described and information is given on: standards for the α wastes and their handling; treatment of the α wastes at ordinary β and γ disposal facilities; facilities for the treatment of α wastes; and the disposal of wastes with especially high content of the α wastes. (JA)

Handling Equipment and Procedures

10788 (CEA-CONF-2319) ANTINEA FACILITY: SEALED AND SHIELDED FACILITY FOR THE FABRICATION OF METALLIC ^{238}Pu OF HIGH PURITY. Baudoin, J. C.; Drieu, F.; Damien, D.; Faudot, G.; Lefort, G. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 19p. (In French). (CONF-720649-6). Dep. NTIS (U.S. Sales Only) $3.75.

From 14th committee of hot laboratories of EURATOM; Petten, Netherlands (8 Jun 1972).

In order to obtain production of high-purity ^{238}Pu a α-γ neutron facility was constructed. This ensemble will be equipped to produce metallic Pu in 100 g lots for commercial sources. This facility where all the operations are done at a distance has shielding consisting of 80 cm steel cases filled with water. It has five stainless steel glove boxes connected by removable lock chambers. The ventilation of each work station is normally assured by circulation of argon permanently purified with less than 50 VPM impurities. In order to attain this result all points capable of being the cause of interior or exterior contamination were specially restudied and adapted. (tr-auth)

10789 (CEA-CONF-2415) METHODS IN USE AT CEN SACLAY FOR THE TRANSPORT, STORAGE, REMOTE HANDLING, AND EXAMINATION OF FUEL ELEMENTS FOR A LIGHT WATER CHANNEL. Roussel, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). [nd]. 25p. (In French). (CONF-730667-4). Dep. NTIS (U. S. Sales Only) $3.25.

From fifteenth meeting of the committee on hot laboratories of Euratom; Gaesthacht, F. R. Germany (14 Jun 1973).

The importance of the investments predicted for the construction of reactors of the light water type during the next decade in Europe requires the availability in the nuclear study centers of methods of examination and expertise adapted to the large dimensions of the

fuel elements. The totality of the means made available at CEN Saclay for this purpose is described. These include a method of transport, cells for the dismantling of fuel elements, examination of the fuel rods, and methods for the storage of the rods. Each of these facilities is described. (JSR)

10790 (WASH-1264) EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT SHIPPING HIGH-LEVEL NUCLEAR WASTES. (USAEC Division of Waste Management and Transportation, Washington, D. C.). Sep 1973. 49p. GPO.

Sixty-eight "most often asked" questions concerning the safety of high-level waste shipping with detailed answers are presented. Although the questions and answers are aimed specifically at transportation of nuclear wastes, many of them are equally applicable to shipments of other nuclear materials, such as spent fuel elements and large amounts of radioisotopes. (TFD)

10791 RADIOACTIVE SOURCE HANDLING APPARATUS. Orange, J. M. (to Gulf Research and Development Co.). US Patent 3,773,376. 20 Nov 1973. Filed date 3 Sep 1971. 8p.

An apparatus for safely handling, substantially remotely, small articles which are dangerous if brought excessively close to humans, such as radioactive sources is described. The invention comprises a non-round, cross-sectional shape in the body of the source holder with a groove formed in that shaped portion, and a carrier member having a mating internal shape to fit over the shaped body to turn the holder and source, and provided with a spring loaded detent pin to fit into the groove in the holder to thereby lift and lower and carry the holder and source. (14 claims, 10 drawing figures) (Official Gazette)

10792 CALCULATIONAL METHODS FOR INTERACTING ARRAYS OF FISSILE MATERIAL. Thomas, A. F.; Abbey, F. Oxford; Pergamon Press (1973). 138p.

Treatment of the subject is aimed at the criticality specialist, describing the basic principles involved as illustrated by a number of methods of calculation which have proved their worth in daily use at major establishments. The chapters are entitled: the general nature of the interaction problem; the problem in practice; simple hand methods (general equilibrium conditions in interacting arrays, the Oak Ridge method, the interaction parameter method, comparison of the Oak Ridge method and the interaction parameter method, the PQR method); Monte Carlo methods (GEM - neutron tracking). (UK)

10793 METALLOGRAPHIC PREPARATION AND INVESTIGATION OF NUCLEAR FUELS WITH HIGH BURNUP IN HOT CELLS. Pejsa, R.; Hellriegel, W. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From meeting on the metallography of the Deutsche Gesellschaft fuer Metallkunde e.V; Iserlohn, Germany (12 Sep 1973).

The first part of the paper describes the experimental facilities for studying high burnup fuels in hot cells; the second part deals with the preparation methods used for the experiments and the results obtained. (GE)

10794 HANDLING OF RADIOACTIVE SOURCES. Ellis, J. (to Sidney Geoffrey Young). British Patent 1,330,302. 19 Sep 1973. Filed date 17 Jul 1969. 10p.

A method is described for handling an isotope capsule carried at the end of a source holder comprising retracting the source holder into a curved passage in a guide member through an inlet at one end of the passage, turning the guide member through an angle of less than 360° about the central axis of the other end of the passage, and then ejecting the source holder through the inlet into a different position. Manipulating apparatus is also described for withdrawing and inserting a source holder from and to a hole in a shielded transport container and for transferring the source holder to and from a location beyond the container. This apparatus comprises a curved tube adapted to receive the source holder and mounted for rotation about the central axis of one of its ends, so that the other end can be selectively brought into alignment with the hole in the container or with a guide path for the source external to the container. Operating mechanism is provided for effecting rotation of the curved tube only in response to movement of the source holder under the action of a remotely driven control cable attached to the holder. Thus if the source holder is in a transport container located in one room it can be retracted along a predetermined path and into the tube whose inlet is in alignment with the path. The tube is then swung through an angle of, say, 180° until its inlet is aligned with a second path leading to a different room, swinging taking place only when the source holder has been fully retracted into the tube. The source holder is then ejected along the second path. A description is given of the operating mechanism. (UK)

Transportation

10795 SHIPPING CONTAINER FOR RADIOACTIVE MATERIAL. Backus, H. A. (to N L Industries, Inc.). US Patent 3,770,964. 6 Nov 1973. Filed date 24 May 1971. 4p.

An impact-resistant shielded container for transporting spent fuel elements or other radioactive materials is described. The shielding consists of depleted uranium and deformable lead. (TFD)

10796 ADMINISTRATIVE GUIDE FOR OBTAINING DEPARTMENT OF TRANSPORTATION SPECIAL PERMITS FOR RADIOACTIVE MATERIALS SHIPMENTS. New York; American National Standards Institute, Inc. (1973). 8p. (ANSI-N-14.10.2-1973).

This standard sets forth the procedure for requesting special permits from the U. S. Department of Transportation (DOT) for packages or transport methods that do not meet the existing DOT regulations for radioactive materials. It outlines and explains the information required by DOT in requests for special permits for exemptions or waivers from DOT regulations. It is not applicable to requests for Atomic Energy Commission approvals of packages referenced in Title 49, Code of Federal Regulations, Part 173.394, Radioactive Materials in Special Form; Part 173.395, Radioactive Materials in Normal Form; or Part 173.396, Fissile Radioactive Material. (auth)

10797 CLAMP FOR FIXING FUEL ELEMENTS IN TRANSPORT CONTAINERS. Schubert, F.; Katscher, E.; Weber, R. (to Siemens AG). German Patent 1,816,856. 9 Jul 1970. Filed date 24 Dec 1968. (In German).

A device is described for clamping nuclear fuel elements in transport containers in which they rest. The elements can be fixed in a certain position by a system of threads on rotating crossbraces. (TSS)

10798 DUALLY SEALABLE, NON-LEAKING VIAL FOR SHIPPING RADIOACTIVE MATERIALS. Novitch, H. (to New England Nuclear Corp.). US Patent 3,770,155. 6 Nov 1973. Filed date 19 Oct 1971. 6p.

A dually sealable, non-leaking vial is described for shipping liquid radioactive materials, particularly sterile radioactive materials, and other sterile liquid materials in which the mouth of the vial, as shipped, is sealed by a needle pierceable septum seal and in which a threaded cap is located and held over the septum seal and mouth with the threads thereby held out of engagement with mating threads on the vial by the septum seal. However, upon removal of the septum seal after shipment, the threads of the cap mate with the threads of the vial whereby the cap can be removably threaded tightly over the mouth to seal it. The capped and septum-sealed loaded vial is placed in a heat shrinkable plastic envelope having a bottom end wall and an upstanding cylindrical wall of greater height than the capped, septum-sealed vial and of lesser thickness than the bottom end wall and the envelope is heat shrunk circumferentially, tightly and sealably around the capped septum-sealed vial with the upper part of the envelope being shrunk circumferentially and downwardly tightly over the margin of the upper surface of the cap to securely seal the capped septum-sealed vial. (Official Gazette)

10799 ISOTOPE CONTAINER. Ellis, J. (to Sidney Geoffrey Young). British Patent 1,330,301. 19 Sep 1970. Filed date 17 Jul 1969. 4p.

A shielded transport container for a radioactive source is described, constructed so that it can also serve as a storage or exposure container for the source. It comprises an unsegmented solid core encased in a shield, with a blind hole in the core for accommodating a source holder that is withdrawable through an aligned opening in the shield and a removable closure cap for covering the opening in the shield. A separable withdrawal mechanism for the source holder is attachable to the shield when the closure cap has been removed but while the source holder is still accommodated in the blind hole, and the shield is provided at its opening with a connector with which the closure cap is engageable. The connector comprises a displaceable safety screw engageable in a recess or groove in the source holder to lock the latter in the blind hole, and which is inaccessible when the closure cap is engaged with the connector. The shield may be of malleable iron and fitted with a pedestal at its base, and the blind end of the blind hole is fitted with a receptacle for an isotope capsule. (UK)

PARTICLE ACCELERATORS

Design, Development, and Operation

10800 (AECL-4600) CONCERNING A HIGH CURRENT COLLECTIVE ACCELERATOR. Chuvilo, I. V.; Kapchinskii, I. M.; Koshkarev, D. G.; Zenkevich, P. R.; Plotnikov, V. K.; Globenko, Yu. G. Oct 1973. Translated by J. A. Hulbert from Symposium on Collective Methods of Acceleration, Dubna, USSR, 27–30 September 1972. (CONF-720952-8). 14p. Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on collective methods of acceleration; Dubna, USSR (27 Sep 1972).

A study has been made of possible parameters for a high current electron-ring proton accelerator suitable for use as a meson factory. Ignoring possible problems associated with the mechanics and efficiency of ring formation, the limitations imposed by electron-ion resonance coupling (including electron-electron interaction effects) the negative mass instability, and technical feasibility of ring compression repetition rate indicate a magnetic accelerating column 190 meters long for 1 mA of 1 GeV protons. Further studies are advocated to determine the validity of the preliminary conclusions drawn. (auth)

10801 (BARC-692) VAN DE GRAAFF LABORATORY PROGRESS REPORT. David, T. P. (comp.). (Bhabha Atomic Research Centre, Bombay (India). Nuclear Physics Div.). 1973. 86p. Dep. NTIS (U.S. Sales Only) $6.50.

Operation of the 5.5-MV van de Graaff accelerator is reviewed. Brief accounts of experiments done with the accelerator are given. Work on instrumentation for the accelerator, such as the design of quadrupole magnet power supplies, is discussed. Ion implantation studies, particularly on Si, are recounted. Design and construction of a 2-MV tandem accelerator and an isotope separator are described. The work of the Indian nuclear data group is outlined. (24 figures, 3 tables) (RWR)

For title listings of selected papers see: 11416 and 11452.

10802 (CONF-720948-, pp 682-688) LOW INTENSITY AND LOW ENERGY DISPERSION ION SOURCE FOR SPACE PHYSICS. Thevenet, P.; Gillon, J. C. (Groupe de Recherches Ionospheriques, Saint-Maur, France). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

In order to test and calibrate low-energy particle detectors for space experiments, an accelerator producing ions and electrons in the energy range 100 eV to 50 keV has been designed and built in our laboratory. The accelerator consists of an electron-impact ion source with a magnetic analyzer. This apparatus, although specifically designed for calibration of space experiments, may also be used in other types of studies such as cross section measurements and ion-ion reaction rates. (auth)

10803 (CONF-720948-, pp 908-915) PRODUCTION OF A NEGATIVELY CHARGED Ca-BEAM FOR A MP-TANDEM ACCELERATOR. Kutschera, W.; Korschinek, G. (Technische Universitaet, Munich). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A negatively charged Ca-beam has been produced with a duoplasmatron ion source running with He and a charge exchange canal fed with Ca vapor. 600 nA of Ca^- could be extracted out of the canal and were used for a three days run at the Munich MP-Tandem. With 9 MV terminal voltage and carbon foil stripper the following ^{40}Ca beam currents were analyzed after the 90° magnet: 5 nA(6^+), 25 nA(7^+), 60 nA(8^+), 70 nA(9^+), 80 nA(10^+), 30 nA(11^+), 5 nA(12^+). (auth)

10804 (JPRS-60651) ACCELERATION OF IONS BY A RELATIVISTIC ELECTRON BEAM. Plyutto, A. A.; Suladze, K. V.; Temchin, S. M.; Mkheidze, G. P.; Korop, E. D.; Tskhadaya, B. A.; Golovin, I. V. Translated from Zh. Tekh. Fiz.; 43: No. 8, 1627-1631(1973). 8p. NTIS.

The effect of ion acceleration by a relativistic electron beam was investigated. Protons were accelerated to 6 to 7 MeV for an energy of an electron beam of approximately 1 MeV. The beam composition and its energy distribution were studied. It was demonstrated that the energy of protons accelerated by electrons rises more rapidly than linearly with an increase in the accelerating voltage in the 0.3 to 1 MeV. The effect of ion acceleration in an electron beam was observed initially when obtaining nonrelativistic electron beams from a plasma emitter. Protons and ions of carbon with maximum energies of 4 to 5 and 10 to 20 MeV were recorded in the following experiments for an average of 200 to 300 keV electron energy. A linear rise in the energy of ions with an increase in the energy of electrons was observed in the range of 10 to 200 kilovolt accelerating voltages under optimal conditions for ion acceleration. This opened up the possibility for creating an electron jet ion accelerator at 10 to 100 MeV using 1 to 2 MeV relativistic electron beams. Some investigations in this direction were conducted using high current electron resonator accelerators. (auth)

10805 (JPRS-60880) NANOSECOND ELECTRON ACCELERATOR. Mesyats, G. A.; Bugaev, S. P. Translated From Priroda; No. 6, 78-84(1972). 12p. NTIS.

The nanosecond electron accelerator, the explosive emission of electrons, the generation of nanosecond impulses, the obtaining and focusing of relativistic electron fluxes and the application of high-power electron beams are discussed. (auth)

10806 (LPS-136) HIGH POWER ELECTROSTATIC ION ACCELERATORS. Humphries, S. Jr. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Plasma Studies). Oct 1973. Contract AT(11-1)-3170. 19p. Dep. NTIS $3.00.

A simple electrostatic diode is described in which it should be possible to efficiently accelerate high ion currents (100 A/cm^2 or greater) for short times (10^{-7} sec). With the addition of a magnetic field to this device, it may be possible to exceed the Child–Langmuir current density limit. Aspects of high-current ion beam propagation, neutron production, and experimental possibilities are also discussed. (auth)

10807 LINEAR PARTICLE ACCELERATOR. Kura, M.; Oshima, K. (to Tokyo Shibaura Electric Co. Ltd.). Japanese Patent 1973-278. 13 Sep 1969. 3p. (In Japanese).

The microwaves generated from a magnetron are transmitted into an accelerator tube through a variable attenuator and a directional coupler. The attenuator comprises a waveguide and one or more pairs of quartz tubes which are located within the waveguide laterally with respect to waveguide's axis. A fluid such as water or air flows through the quartz tube and a heat exchanger to act as an absorber for microwaves, and the absorption coefficiency for microwaves varies with its temperature. A detecting means which is provided in the directional coupler measures the transmitting microwave power. The detected signals representing the power are fed to a comparative amplifier where they are compared with a predetermined level. Error signals are generated from the comparator to control the opening ratio of electromagnetic valves which determines the flow rate of coolant which is passed through the heat exchanger. Thus the suitable temperature of the fluid as an absorber is regulated, whereby the desired microwave power transmitted into the accelerator may be obtained over a lower range as well as over a higher range. (JA)

10808 POLARIZATION OF ELECTRONS FROM HIGH ENERGY ACCELERATOR. Arikawa, T. (Tokyo Univ.); Huke, K. Jap. J. Appl. Phys.; 12: No. 9, 1472-1473(Sep 1973).

10809 HIGH INTENSITY, LOW POWER ACCELERATORS. Peto, G. (Kossuth Lajoe Tudomanyegyetem, Debrecen, Hungary). Izotoptechnika; 16: No. 10, 561-577(Oct 1973). (In Hungarian).

Power supplies, ion sources, and targets for high-intensity low-power accelerators are discussed. (54 references) (auth)

10810 PROGRESS IN CONSTRUCTION OF THE SPS. Part II. Controls, r.f., Civil Engineering and Experimental Areas. CERN Cour.; 12: No. 13, 363-368(Dec 1973).

Development and construction progress on the CERN II Synchrotron is summarized. The control system, which will be composed of many small and medium sized computers, is described. Manufacture of all the necessary rf components is reported to be under way. Civil engineering aspects are summarized, and the general scheme of the experimental areas is described. (WHK)

10811 LARGEST NUCLEAR ACCELERATOR EXPECTED TO BRING MANY BENEFITS. Nucl. Can.; 13: No. 5, 6(Jul 1973).

The construction of TRIUMF, Canada's largest nuclear accelerator, is briefly described. The cyclotron, which possesses a 4000-ton magnet assembly energized by three megawatt coils and a 60-ft diameter high-vacuum chamber, will accelerate protons to 500 MeV and provide a greater yield of mesons than any present facility in the world. Intended applications for TRIUMF are summarized. (CA)

Auxiliaries and Components

10812 (CONF-720948-, pp 183-189) FAST RESPONSE ABSOLUTE ION BEAM MONITOR. Dalglish, R. L.; Kelly, J. C. (Univ. of New South Wales, Kensington, Australia). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The operation and calibration of a toroidal induction detector for beam monitoring are described. The detector is absolute; independent of contamination, energy, and beam species; has a 10^{-12} amp sensitivity, gives the two-dimensional profile of the beam current density; and is potentially capable of giving the energy profile of the beam. (WHK)

10813 (JINR-P16-7335) SHIELDING FROM THE NEUTRONS GENERATED IN TARGETS BY PROTONS WITH THE ENERGY FROM 25 TO 400 MEV. Komochkov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

A comparatively simple method of estimation of radiation shielding and environment is described. This permits decisions to be made on the questions of radiation protection on proton accelerators with the energy of tens and hundreds of MeV. The results of calculations are compared with analogous data of other papers. (auth)

10814 (LBL-2418) LBL SUPERCONDUCTING ACCELERATOR DEVELOPMENTS. Gilbert, W. S. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 19p. (CONF-731115-5). Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

Research progress on the LBL Superconducting Experimental Accelerator for accelerating protons from 50 MeV to 5 GeV at a maximum dipole field of about 50 kG is described. Work on pulse dipoles and transport magnets is outlined, and superconductor development and testing is reviewed. (WHK)

10815 (RL-73-96) CONSTANT PERIMETER END. Rosten, H. I. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

A mathematical model of a constant perimeter saddle wind is described. Also described is a program for calculating the magnetic field from a dipole electromagnet (current only–iron free) with such ends. (auth)

10816 (RL-73-109) DESIGN STUDY OF IRON CONFIGURATION FOR BEAM LINE DIPOLES (SUPERCONDUCTING). McInturff, A. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

A design study was made of various dipole-iron shield configurations. The magnet design parameters and results are tabulated. A detailed study was restricted to gaps of 1 cm or less and iron jackets 15 to 20 cm thick, at 6.0T or less central bore fields. It is concluded that it is possible without great difficulty to make a magnet which is magnetically efficient, of a reasonable beam quality. It is stated that the 1 cm gap is preferred at present but that the development of magnet materials with similar shrinkage coefficients to liquid helium temperatures would make it possible to eliminate the gap, thus giving sizable weight reduction and dewar savings. (UK)

10817 (SLAC-Trans-159) PROTECTION AGAINST REENTRY OF AIR INTO VACUUM INSTALLATIONS. Jean, R.; Rauss, J. Translated from Vide; No. 111, 123-127(1964). 16p. Dep. NTIS $3.00.

Protection of vacuum installations, particularly particle accelerators, against a sudden reentry of air through rupture of a wall is difficult to accomplish with only the use of a fast-closing cock. When the latter is supplemented with an "acoustic"-delay line whose functioning is actually based on the divergence of jets in rarefied media, it is possible to increase considerably the transit time of air through a tube and thereby to ensure effective protection. The experimental results and expedients tried on various installations are described. (auth)

10818 PARTICLE BEAM PULSING DEVICE WITH A RESONANCE CABLE CONNECTED TO DEFLECTING CONDENSERS. Paulin, A. (SIN-ETH, Zurich). Nucl. Instrum. Methods; 113: No. 3, 341-347(1973). (In German).

A pulsed beam can be produced after acceleration by periodic deflection of a continuous beam. For first and odd harmonics a quarter wave length cable transforms the low voltage from the short circuited end to a high voltage on the deflecting plates terminating the open end. By proper adjustment of phase and power at each frequency, a fairly good pulse form can be created. The feasibility of such a device for 600 MeV protons is shown. (auth)

10819 DEEP PENETRATION HADRON CASCADE CALCULATIONS AND COMPARISONS TO MEASUREMENTS IN IRON AT 24 GeV/c. Goebel, K.; Ranft, J.; Routti, J. T. (CERN, Geneva). Nucl. Instrum. Methods; 113: No. 3, 433-444(1973).

Monte Carlo methods are used to simulate extranuclear hadron cascades resulting from a high energy proton beam incident on a block of material. The calculated star and energy deposition densities compare favorably to measurements with activation and dose meters, respectively, in a large muon stopper made of iron and irradiated by a 24 GeV/c proton beam at the CERN Proton Synchrotron. Results of calculations at 200 to 400 GeV/c are also presented. (auth)

10820 PROCEDURE FOR INVESTIGATING THE PARAMETERS OF SUPERCONDUCTING RESONATORS. Zlunitsyn, E. S.; Zykov, A. I.; Kushnir, V. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 947-949(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 243-245(1973).

An installation is described for the investigation of superconducting resonators for the 10-cm range in powerful microwave fields. Data are presented on a superconducting resonator with a lead galvanic coating at an amplitude of the axial high-frequency electric field ranging up to 100 kV/cm. (auth)

10821 MICROWAVE STRUCTURE WITH PARALLEL TRANSVERSE RODS. Zubovskii, V. P. (Moscow Engineering Physics Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 12, 2029-2030(Jun 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 12, 2611-2612(Dec 1972).

An experimental study is made of the microwave characteristics of structures with parallel pairs of transverse rods. The frequency, group velocity, and attenuation are determined as functions of the dimensions of the structure for a constant phase velocity and mode of propagation. The results, in conjunction with data reported earlier, make possible the analysis and design of accelerating systems using such structures. (auth)

10822 RADIOFREQUENCY SYSTEM OF THE IPCR (RIKEN) VARIABLE ENERGY MULTI-PARTICLE CYCLOTRON. Odera, M.; Chiba, Y.; Fujisawa, T.; Miyazawa, Y.; Terajima, O. (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 3, 99-113(Sep 1973).

The Riken (IPCR) Cyclotron is a variable-energy multi-particle machine which is capable of accelerating protons, deuterons, helium-3, alpha-particles and also heavy ions such as carbon, nitrogen and oxygen in a wide range of energy. The design and performance of its radiofrequency system are described. The system is required to work in a frequency range from 5 to 13.5 MHz and estimated to consume maximum power of 150 kW including beam load. Use of a pair of movable liners, a moving shorting plane and an additional fixture to change the shape of the shorting plane makes coverage of the required frequency range possible without excessive power dissipation. All adjustment of the parameters necessary for operation can be made at the control panel remotely, except the addition of a small capacitor to the anode of the oscillator tube at some low frequency region. The need to enter the cyclotron vault is not frequent. No special precaution necessary for operation has been felt for six years by virtue of the conservative design. A testing method devised to measure the characteristics of a resonator having a large Q value is described. Some mechanical features of the rf system are also given. (auth)

Ion Sources and Injection and Extraction Systems

10823 (CONF-720948-, pp 471-476) UNIVERSITY OF MINNESOTA POLARIZED NEGATIVE ION SOURCE. Poppe, C. H.; Shkolnik, V. (Univ. of Minnesota, Minneapolis). 1972.

From second international conference on ion sources, Vienna, Austria (11 Sep 1972).

The operation of the atomic beam source, based on selection of appropriate hyperfine states of ground state H atoms by a strong non-uniform magnetic field is described. A beam of either hydrogen or deuterium atoms is formed by molecular dissociation in an rf discharge and goes through a differential pumping column into a sextupole magnet chamber where the $M_J = +1/2$ electronic spin component of the atomic beam is focused into an electron bombardment ionizer, where positive ions are extracted at 5 to 8 keV. Negative ions are produced by charge exchange of the positive ion beam in sodium vapor. Preliminary test results are discussed. (WHK)

10824 (CONF-720948-, pp 477-482) KYUSHU UNIVERSITY POLARIZED ION SOURCE. Sonoda, M.; Wakuta, Y.; Hasuyama, H.; Tsuji, K.; Aramaki, F. (Kyushu Univ., Fukuoka). 1972.

From second international conference on ion source; Vienna, Austria (11 Sep 1972).

A polarized ion source based on a conventional atomic beam principle is described. Two sextupole magnets are used in series. One has tapered pole tip up to the center of the magnet and the other has constant aperture throughout the entire length. The tensor polarization of deuterons is obtained by detecting neutron anisotropy in $^3H(d,n)^4He$ reaction. The obtained polarization is $P_{33} = +1/2$ and -0.71 for $2 \rightarrow 6$ and $3 \rightarrow 5$ transition, respectively. The polarized beam intensity is about 1 nA at the deuterium target. (auth)

10825 (CONF-720948-, pp 491-497) SOURCE FOR POLARIZED POSITIVE AND NEGATIVE LITHIUM IONS. Ebinghaus, H.; Holm, U.; Neuert, H.; Steffens, E.; Wittchow, F. (Univ., Hamburg). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The polarized lithium ion source using the atomic beam method at Hamburg is described. An iron oven heated to 850 to 900°C delivers an intense Laval beam of lithium atoms in the ground state $2S_{1/2}$. A strong inhomogeneous magnetic sextupole field separates the atoms with a magnetic quantum number $M_J = +1/2$ from those with $m_J = -1/2$. The beam is then ionized by high-frequency transitions, and the positive lithium ions are charge exchanged in cesium to form negative lithium ions for injection into the tandem accelerator. (WHK)

10826 (CONF-720948-, pp 498-504) LAMBSHIFT TYPE POLARIZED ION SOURCE DESIGNED FOR THE ISOCHRONOUS CYCLOTRON IN KARLSRUHE. Bechtold, V.; Brueckmann, H.; Finken, D.; Friedrich, L.; Hamdi, K.; Strassner, G. (Univ., Karlsruhe, Ger.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The operation and performance of a Lambshift polarized ion source for the Karlsruhe isochronous cyclotron are discussed. Iodine is used as the charge exchange medium. (WHK)

10827 (CONF-720948-, pp 512-518) ION SOURCE FOR THE PRODUCTION OF MULTIPLY CHARGED IONS FROM SOLID MATERIALS. Pasyuk, A. S.; Tretyakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

For a few years a PIG indirectly heated cathode source with reflex discharge has been operated in the JINR Laboratory of Nuclear Reactions cyclotrons. This type of source has proved most efficient among all the existing ones. In particular, the bench tests permitted the production of Kr^{11+} and Xe^{13+} ions. However, the use of this source under normal operating conditions is limited to elements having gaseous or high vapor pressure compounds. In order to produce multiply charged ions from solid compounds, sources were developed in which the ionized material is fed into the discharge by cathode sputtering or is vaporized. The results of the bench tests and performance of these sources in the U-300 cyclotron are presented. (auth)

10828 (CONF-720948-, pp 535-541) MULTICHARGED HEAVY ION SOURCES AT BERKELEY 88 INCH AND UNIVERSITY OF LOUVAIN CYCLOTRONS. Clark, D. J. (Lawrence Berkeley Lab., CA); Steyaert, J. 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A heavy ion source of the PIG type has been in operation at the Berkeley 88 inch cyclotron for one year. The maximum energy for ions heavier than α-particles is now 140 q^2/A MeV. Beams of lithium, carbon, nitrogen, oxygen, neon and iron have been accelerated and used in experiments in the energy range 4 to 18 MeV/nucleon. Cathode life-time is about 3 to 10 hours. The source is assembled on an axial shaft and an alumina base insulator forms a vacuum seal. An important design parameter is the arc chamber diameter to length ratio. The higher the ratio, the more the tantalum vapor penetrates the center of arc and the less high charge states are produced. External beam intensities are 1 to 10 μA of most carbon, nitrogen and oxygen beams. The Louvain cyclotron CYCLONE has been in full operation since October 1972 and has produced up to 30 nA of N^{4+} at 96 MeV during initial tests. (auth)

10829 (CONF-720948-, pp 542-548) MULTICHARGED HEAVY ION SOURCE FOR THE GRENOBLE ISOCHRONOUS CYCLOTRON. Lieuvin, M.; Rallu, G. A. (Institut des Sciences Nucleaires, Grenoble, France). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The Grenoble variable energy isochronous cyclotron is a two dee machine permitting the acceleration of protons up to energies of 65 MeV and heavier particles up to an energy given by: $E = 83\ n^2/A$ (MeV), n being the charge state and A the mass number. Heavy ion accelerating tests have been already made with the actual source which is of the Livingston type, and we have obtained an internal beam of roughly 10^{-9} A of N^{4+} at 95 MeV. To replace this source, an internal heavy ion source has been built and will be mounted in the machine in December 1972. The source is of the reflex type with radial introduction. The preliminary results presented have been obtained in a bench test rig. (auth)

10830 (CONF-720948-, pp 559-576) PERFORMANCE OF THE HEAVY ION AXIAL INJECTOR FOR THE HARWELL VARIABLE ENERGY CYCLOTRON. Burrows, B. J. C.; Green, T. S. (Culham Lab., Abingdon, Eng.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The axial injector for the Harwell Variable Energy Cyclotron has been designed to replace the internal source for the production of multiply charged heavy ions. The ions are accelerated through 15 to 25 kV, their charge state is selected by magnetic deflection and after being transported 6 meters they are deflected into the median plane of the cyclotron by an electrostatic mirror. An investigation of the overall system up to the electrostatic mirror has been carried out to determine its performance with the injector temporarily installed at the Culham Laboratory. Results of this study are presented. (auth)

10831 (CONF-720948-, pp 724-762) TECHNOLOGY AND CHEMISTRY OF HEAVY ION SOURCES. Freeman, J. H. (Atomic Energy Research Establishment, Harwell, Eng.); Sidenius, G. 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

Some of the chemical and technological problems of heavy-ion sources are reviewed. Ion source parameters are defined; and constructional materials, design considerations, and material transport and ion source chemistry are discussed. Also, a table of recommended source feed compounds for all the elements up to Z = 97 is given. The table lists the ionization potentials, the source feed compounds, and the support gas. Also, the temperatures for different pressures and the melting points are listed. (WHK)

10832 (CONF-720948-, pp 770-783) ION SOURCE DEVELOPMENT IN THE APPLIED PHYSICS AND TECHNOLOGY DIVISION CULHAM LABORATORY. Green, T. S. (Culham Lab., Abingdon, Eng.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A brief review of ion source development at the Culham Laboratory which shows the diversity of applications of sources and the unity in the underlying physics and technology is given. Three types of sources are at present under development: a Penning Ionization Source (PIG) for production of multiply charged heavy ions; an electron bombardment mercury ion thrustor for electrostatic propulsion of space vehicles; and a reflex source similar to b for production of intense hydrogen beams. (auth)

10833 (CONF-720948-, pp 825-830) Li^{3+} ION SOURCE FOR EXTERNAL INJECTION INTO THE KARLSRUHE ISOCHRONOUS CYCLOTRON. Haushahn, G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A Penning type ion source (PIG) with two externally-heated cathodes was developed to match the ion injection system recently installed at the Karlsruhe Isochronous Cyclotron. With an extraction voltage of 10 kV, a Li^{3+} current up to 0.5 μA can be obtained. The characteristics of some other Li^{3+} ion sources were investigated and are briefly discussed. (auth)

10834 (CONF-720948-, pp 901-907) NEGATIVE HELIUM ION SOURCE WITH POTASSIUM VAPOR CHARGE EXCHANGE. Vermeer, A.; Van Zwol, N. A.; Strasters, B. A. (State Univ., Utrecht). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

Operating experience with a duoplasmatron ion source for a tandem Van de Graaff accelerator is described. The potassium vapor charge exchange system is discussed, and the helium recovery system is described. (WHK)

10835 (CONF-720948-, pp 916-921) PROGRESS IN THE DEVELOPMENT OF A 30-HERTZ PULSED H^- ION SOURCE FOR THE ZGS RAPID-CYCLING BOOSTER. Fasolo, J. A.; Marmer, G. J.; Moenich, J. S.; Abraham, J.; Gorka, A. J.; Timm, R. E. (Argonne National Lab., IL). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A tandem-acceleration H^- ion source has met the 8-pulse/sec requirements for Phase I of the ZGS (Zero Gradient Synchrotron) rapid-cycling booster program by producing 11 mA of negative beam at 10 pulses/sec and 8 mA at 16 pulses/sec in bench tests of limited duration. It is undergoing continuing development to improve operational reliability and life and further development to satisfy the 30-pulse/sec requirements for Phase II. Results of this development program and design and performance characteristics of the source and related systems are presented and discussed. (auth)

10836 (JINR-P9-7449) STUDY OF BEAM EXTRACTION IN THE ELECTRON MODEL OF THE RING CYCLOTRON. Dmitrievskii, V. P.; Zamolodchikov, B. I.; Zaplatin, N. L.; Leshchenko, G. P.; Novikov, D. L.; Onishchenko, L. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 24p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.25.

The results of a study of beam extraction in the electron model of the ring cyclotron are presented. The extraction is performed in the area where radial oscillation frequency is close to 2. The analysis of those factors is made which can influence the value of the radial beam separation. The particle extraction coefficient is obtained to be about 80%, in this case the beam current at the deflector output is 240 μA. (auth)

10837 (RL-73-127) 70-MeV INJECTOR ALIGNMENT PROPOSALS. Part 2. LEDS and DC Gun Alignment. Lascelles, R. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 5p. Dep. NTIS (U. S. Sales Only) $3.00.

To facilitate installation of the NIMROD 70-MeV injector, it is proposed to install a temporary floor datum in the EHT area, and a wall target on the end wall, in line with the datum line of sight. This will allow the preinjector and LEDS (Low Energy Drift Space) components to be aligned, without requiring access to the tanks. Details are given, with a diagram of the equipment. (UK)

10838 (RL-73-134) 70-MeV INJECTOR ALIGNMENT PROPOSALS. Part 3. Alignment of Floor Datum and Height Reference Points. Jarvis, H. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Nov 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

To facilitate installation of the Nimrod 70-MeV injector a series of datum points will be installed in the new injector hall and precisely aligned relative to the existing Nimrod datum network. A method of aligning these datum points is proposed, with explanatory diagrams of the areas and equipment involved. (UK)

10839 TRAPPING AND REGENERATING NEON AND XENON GASES. Ivanenko, A. I.; Tumanov, K. D.; Filipson, A. N. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 16: No. 3, 940-943(1973).

Translated from Prib. Tekh. Eksp.; 16: No. 3, 237-240(1973).

The diagrams of installations for trapping and regenerating Ne and Xe gases which are fed to a source of multiply charged ions in a cyclotron are presented. The principle of operation of the installations for separating the indicated gases from impurities is described along with the construction of the traps. The installations allow the performance of 6 to 8 complete regeneration cycles while retaining a high degree of enrichment. (auth)

Ion Optics and Field Calculations

10840 (BNL-18380) COS THETA DIPOLE OF 12-CM APERTURE. Dahl, P. F. (Brookhaven National Lab., Upton, N. Y. (USA)). 20 Nov 1973. 6p. Dep. NTIS $3.00.

The conductor distribution in a cos θ dipole of 12-cm aperture (inner coil diameter) is summarized. Included are calculated field shapes for the case of an infinite-μ iron shield. The multipoles introduced by random as well as systematic errors in conductor location are examined. (auth)

10841 (CERN-73-16) TRANSPORT: A COMPUTER PROGRAM FOR DESIGNING CHARGED PARTICLE BEAM TRANSPORT SYSTEMS. Brown, K. L.; Rothacker, F.; Carey, D. C.; Iselin, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 15 Nov 1973. 121p. Dep. NTIS (U.S. Sales Only) $8.25.

TRANSPORT is a first- and second-order matrix multiplication computer program intended for the design of static-magnetic beam transport systems. The original TRANSPORT program has been revised several times and the standard version of the resulting program which has been adopted at SLAC, NAL, and CERN is described. (WHK)

10842 (CONF-720948-, pp 176-182) ABERRATION FREE LONG FOCAL LENGTH MAGNETIC LENSES. Dalglish, R. L.; Kelly, J. C. (Univ. of New South Wales, Kensington, Australia). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A computer program for analyzing the magnetic field of iron-cored lenses and for calculating the trajectories of charged particles in the field is briefly discussed. The aberrations of the lenses can be analyzed so that the lens can be designed to minimize the aberrations. (WHK)

10843 (CONF-720948-, pp 450-461) SPACE CHARGE POTENTIAL OF A BEAM PASSING THROUGH A TRANSVERSE MAGNETIC FIELD. Green, T. S.; Burrows, B. J. C. (Culham Lab., Abingdon, Eng.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The first stage of the axial injector for the Harwell Variable Energy Cyclotron consists of a P. I. G. ion source, an extraction electrode system and a selector magnet. Measurements of the transmission through the magnet indicated there was incomplete space charge neutralization of the beam. To obtain an understanding of this problem, the plasma produced by the ion beam (He^+) passing through the background gas (He from the source was studied using Langmuir probes. Observations of the parametric variations lead to the conclusion that different mechanisms are responsible for the lack of space charge compensation. (WHK)

10844 (JINR-P9-7261) LIMITS OF EFFECTIVE ACCELERATION FIELDS IN ERA. Makhan'kov, V. G.; Meshcheryakov, M. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The limits on effective acceleration fields in the ERA method concerned with the electron ring instability are discussed. Comparison of the results of two theoretical (and numerical) models shows a quite considerable difference which indicates that the estimations of those early derived limits are incorrect. (auth)

10845 (RL-73-98) MAGNETIC FIELD DUE TO A CURRENT CARRYING HELICAL BLOCK OF RECTANGULAR CROSS SECTION. Rosten, H. I. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

A description is given of the mathematical formulation and solution of the problem and of a FORTRAN program BHELIX that evaluates the field at any point in space. The problem is studied for the design of a superconducting dipole magnet for high-energy physics experiments. (auth)

10846 (SLAC-166) ELECTRON TRAJECTORY PROGRAM. Herrmannsfeldt, W. B. (Stanford Linear Accelerator Center, Calif. (USA)). Sep 1973. Contract AT(04-3)-515. 83p. Dep. NTIS $5.45.

The SLAC Electron Trajectory Program is described and instructions and examples for users are given. The program is specifically written to solve electron trajectories in electrostatic and magnetostatic focusing systems. All equations are relativistic and self-magnetic field effects are included. Starting options include Child's Law conditions on cathodes of various shapes. Either rectangular or cylindrically symmetric geometry may be used. The program is in FORTRAN IV and is used on an IBM 360-67 computer. (auth)

10847 RADIAL VARIATIONS OF THE AC MAGNETIC FIELD OF A 5-MeV BETATRON. Bhiday, M. R.; Bhoraskar, V. N. (Univ. of Poona). Indian J. Pure Appl. Phys.; 11: No. 4, 274-276(Apr 1973).

Measurements of a 5-MeV betatron magnetic field have been made using a method developed by the authors earlier [J. Phys. E (Scient. Instrum.), 4 (1971), 330]. The various properties of the betatron field such as the variations of the fractional change of the field with the radius of the stable orbit, the properties of the field index and the relation between the region of orbit stability and double focusing, have been investigated. (auth)

10848 RESISTIVE LOSSES OF ELECTRON RINGS IN A WAVEGUIDE. Voskresenskii, G. V.; Korenev, I. L.; Kurdyumov, V. N.; Levin, M. L. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 12, 1973-1975(Jun 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 12, 2536-2539(Dec 1972).

Expressions are derived for a wide range of ring energies for the resistive losses of a rotating electron ring in a regular waveguide with walls of finite conductivity. (auth)

Storage Rings

Refer also to abstract 11614.

10849 (BNL-18338) WAKE FIELD PRODUCED BY A PARTICLE IN THE PRESENCE OF CONDUCTIVE PLATES: A VEHICLE FOR THE EXCITATION OF THE COUPLED BETATRON-SYNCHROTRON INSTABILITIES. Ruggiero, A. G. (Brookhaven National Lab., Upton, N. Y. (USA)). 22 May 1973. 11p. Dep. NTIS $3.00.

Beam instabilities observed in ADONE were studied. The interaction of a single particle betatron oscillation with conductive plates was analyzed. First, Fourier analysis of the field source was performed, then the usual approach to determine the plate response was used by treating the plates as transmission lines. Finally, with a process of anti-transformation the total response to the oscillation of a single particle was constructed. The wake field decays over a distance which is of the order of magnitude of the length of the plates themselves. Nevertheless, the shape of the wake field depends on the terminating independence. Several cases, for instance matched, open and shorted plates are considered. (auth)

10850 (BNL-18356) BUNCHED BEAM STABILITY IN PROTON–PROTON STORAGE RINGS. Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 8 Nov 1973. 5p. Dep. NTIS $3.00.

Bunched beams can be unstable against longitudinal collective oscillations. In particular, the interaction of a beam with perfectly conducting chamber walls can force the beam into a condition of latent instability. In such a state, growth of oscillation modes can ensue as a result of wall resistivity or as a consequence of the interaction of the beam with resonant structures in the ring. The dependence of the stability criteria on energy, rf voltage, and rf frequency is given. It is shown how a high frequency rf system tends to stabilize the bunches. A specific set of parameters for an essentially nonstacked bunched beam p-p storage ring, parameters that are consistent with using the AGS as an injector, is considered. (auth)

10851 (BNL-18361) CORRECTION COIL FOR RANDOM MAGNETIC FIELD ERRORS IN A SUPERCONDUCTING STORAGE ACCELERATOR. Parzen, G. (Brookhaven National Lab., Upton, N. Y. (USA)). 12 Nov 1973. 10p. Dep. NTIS $3.00.

Some considerations are given on the relative size of the random nonlinear field errors in the magnets of a superconducting storage accelerator and of a conventional warm accelerator. A possible correction coil is presented for the random field errors in the magnets of a superconducting storage accelerator. This correction coil consists of 24 conductors spaced equally around a circle, 12 of which can be independently excited. Each conductor can carry a maximum current of 1000 A, and has the dimensions of 0.32 × 0.008 in. for a 40-kG magnet with a 4-in. aperture. (auth)

10852 (LBL-2422) PEP PROJECT STATUS. Lambertson, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Nov 1973. Contract W-7405-Eng-48. 5p. (CONF-731115-6). Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

Parameters for the PEP (Proton–Electron–Positron) colliding beam facility and the status of the proposed facility are outlined. The design study has been a joint effort by SLAC and LBL. (WHK)

10853 (LBL-2601) EXPERIMENTAL SUPERCONDUCTING ACCELERATOR RING. Lambertson, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1 Nov 1973. Contract W-7405-eng-48. 14p. (CONF-731115-7) Dep. NTIS $3.00.

From seminar on high-energy accelerator science; Tokyo and Tsukuba, Japan (5 Nov 1973).

The LBL proposal for a relatively small synchrotron and storage ring employing superconducting magnets for accerating protons to about 4 GeV is described. (WHK)

10854 (RL-73-117) MULTI-MODE EXCITATION OF A LOSSY LINE BY A PULSED BEAM. Lawson, J. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 6p. (EPIC/MC-35). Dep. NTIS (U.S. Sales Only) $3.00.

One of the problems to be faced in EPIC is the beam loading and extra power loss associated with beam pulses which are short compared to an r.f. wavelength and spaced by many wavelengths. There are basically two effects which can cause additional losses. These arise from (a) non-resonant excitation of the cavity at frequencies close to the r.f. frequency, and (b) resonant or near resonant excitation of higher cavity modes by high frequency components of the current pulse. The effects are analyzed in a sample calculation, applicable (it is stated) to the simplest imaginable physical situation, but illustrating the physical features. (UK)

10855 (SLAC-Trans-160) FUNCTIONING AND OPERATIONS OF THE I.S.R. FAST-VALVE CONTROL SYSTEM. Rochat, Ph.; Delfosse, J. (European Organization for Nuclear Research, Geneva (Switzerland)). Oct 1973. Translated from French Information Bulletin No. 12, July 31, 1973. 6p. Dep. NTIS $3.00.

At present three intersections of the ISR are equipped with fast valves to protect the ISR vacuum chamber against possible implosion of the thin windows used for experiments at those intersections. Installation of more fast valves at another three intersections is planned for next year. The operation of the control system for the fast valves is described. (WHK)

10856 LUMINOSITY OPTIMIZATION FOR STORAGE RINGS WITH LOW-β SECTIONS AND SMALL CROSSING ANGLES. Keil, E. (CERN, Geneva). Nucl. Instrum. Methods; 113: No. 3, 333-339(1973).

The luminosity of storage rings with intersections having small values of the amplitude function and the crossing angle is optimized imposing upper limits on the line density in the two beams and on the linear beam–beam tune shift. It is found that the luminosity is proportional to the energy of the stored particles. It depends on the beam–beam tune shift, the amplitude function, the length of the crossing region, the beam emittance and the line density more weakly than one might expect from simple-minded formulae. In 300 GeV proton storage rings a luminosity above 10^{33} cm^{-2} s^{-1} should be possible. (auth)

10857 BEAM POSITIONS OF THE SPEAR STORAGE RING. Carman, C. R.; Pellegrin, J. L. (Stanford Univ., CA). Nucl. Instrum. Methods; 113: No. 3, 423-432(1973).

The Stanford 2 GeV electron–positron storage ring is equipped with 20 beam position monitors. The principle of beam coupling is analyzed and a calculation is made for the sensitivity to beam current and position, as well as for the intrinsic distortion of this type of monitor. Beam orbit coordinates are reconstructed by scanning the monitor's four electrode signals and the 20 stations around the machine. Normalization of the data and electronics nonlinearity compensation is one of the routine tasks of the computer control system. (auth)

10858 TRANSVERSE COLLECTIVE INSTABILITY EXCITED BY A NON-UNIFORM ν-SHIFT IN INTENSE BEAMS. Month, M.; Jellett, K. (Brookhaven National Lab., Upton, NY). Nucl. Instrum. Methods; 113: No. 3, 453-458(1973).

A model which describes the effect of a non-uniform space charge ν-shift on the resistive wall instability associated with transverse collective oscillations of a beam of particles is proposed. It successfully predicts the overall characteristics of the instability as observed at the CERN ISR: (1) the observation of a current limitation in spite of the proportionate increase in ν-spread as charge is stacked; and (2) the fact that at the onset of instability, beam losses occur at a particular edge of the beam. The model consists simply of the original model of the resistive wall instability, augmented with the effect on the zero-order betatron tune of the equilibrium space-charge forces. It is shown that, under certain circumstances, the space charge distortion of the equilibrium betatron tune distribution function can permit the instability. An important result is that the stable region in W-space (W is a complex quantity depending on the beam characteristics and its environment) is not diminished by the distortion, but rather shifted. A consequence of this result is that an optimization of design should allow stability, even as the beam intensifies and distortion increases. (auth)

Experimental Facilities

Refer also to abstracts 10238 and 10294.

10859 (ANL/CTR-73-2) ACCELERATOR Be-TARGET NEUTRON SOURCES FOR THE CTR MATERIALS PROGRAM. Persiani, P. J. (Argonne National Lab., Ill. (USA)). Oct 1973. Contract W-31-109-eng-38. 14p. Dep. NTIS $3.00.

A preliminary assessment is presented of the potential for utilizing existing accelerator Be-target systems in the CTR Materials Program. The considerations are aimed to partially satisfy the programmatic near-term phase of the technology program. (auth)

10860 (ITEF-942) MODIFIED ITEP SYNCHROTRON INNER TARGET EFFICIENCY. Sokolov, L. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1972. 14p. (In Russian). INIS.

Calculations were made of the efficiency of the inner target of the modified ITEP proton synchrotron. The calculations were made under the assumption that the ionization energy loss of the

protons in the target is compensated by accelerating high-frequency fields. For the case of the placement of the target at the beginning of the large rectangular gap, the dependences of the efficiency on the energy of the accelerated protons were constructed for several Z values of the target material. The results of the calculation of the efficiency for Al targets of the modified accelerator are compared with calculated and experimental data. An analysis is given of the dependence of the efficiency of the target on the placement of the target in the cycle of the magnetic structure of the modified accelerator. (tr-auth)

10861 (JINR-P13-7512) SYNCHROCYCLOTRON MESON BEAM CONTAMINATION. Kuptsov, A. V.; Smirnov, G. I.; Khazins, D. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The relative contamination of pions in the meson beam containing pions, muons and electrons was defined by the method which uses comparison of the measured π^-p differential cross sections with the results of Monte Carlo simulation. (auth)

10862 (NP-19890) CARRIER-LOADED HELIUM-JET TRANSPORT METHOD. Research Report No. 12/1973. Aeystoe, J.; Puumalainen, P.; Valli, K. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Jun 1973. 43p. Dep. NTIS (U.S. Sales Only) $4.25.

The suitability of commercial helium loaded with small amounts of different gases or vapors for the transport of radioactive reaction products over distances of several meters has been investigated experimentally. Negative results were obtained with gaseous carriers. Transport efficiencies of 50 to 100 per cent were obtained with carrier vapors. The vapor appears to form droplets in the system. The recoils are adsorbed physically by the droplets and carried with them through a capillary. There appears to be an active mechanism that forces the heavy constituents to the centre of the capillary cross section. The heavy constituents emerge from the capillary as a very narrow beam. Collection of the transported activity onto a metal foil in a vacuum chamber is possible only when the vapor pressure of the carrier is lower than the pressure of the collection chamber. Vacuum pump oil was found to meet this requirement. The transport and collection efficiency was studied as a function of the relative mass throughput of the oil vapor. A method for determining the optimum mass throughput of the carrier is demonstrated. The internal energetics of the system are discussed. The kinetic energy of a particle to be transported has to be higher than the average thermal energy in order to avoid adsorption onto the capillary walls. This can be achieved by increasing the mass of the particle by means of a carrier or by decreasing the system temperature. In a cooled system, transport over long distances is possible even with pure helium. Application of the carrier-loaded transport method in on-line mass separators is discussed. (auth)

10863 (ORNL-4903, pp 51-57) HPRR AND ACCELERATOR OPERATIONS. Ward, D. R.; Haywood, F. F.; Dickson, H. W.; Fox, W. F.; Littleton, C. P.; Shoup, R. L.; Poston, J. W. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Health Physics Research Reactor operations are summarized; and research on high-density track counting in dielectric track detectors using an electron beam and the development of long-lived tritium targets for neutron generators are briefly discussed. (WHK)

10864 (RL-73-88, pp 125-152) FROZEN SPIN POLARIZED TARGET IN THE OMEGA SPECTROMETER: FEASIBILITY AND PHYSICS INTEREST. Sadoulet, B. 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

It is proposed to install a frozen spin polarized target in the Omega spectrometer during the P.S. shut-down at the beginning of 1975. This implies that all the running periods of Omega in 1975 will be devoted to polarized target experiments. One specific proposal (Direct Measurement of Helicity Amplitudes in $\pi^+p \to K^+\Sigma^+$ and $K^-p \to \pi^-p \to \pi^-\Sigma^+$-PH I/COM-71/7) and one letter of intent (A Study of the $\pi\pi$ and $K\pi$ Interactions above 1 GeV/c^2 using a Polarized Target - PH I/COM-73/9) have been submitted. In this note the physical significance of polarization measurements is discussed and some of the possible experiments using the triggers already installed in Omega are reviewed. The technical problems of installation are considered and the insertion of polarized target experiments in the long range programme of Omega is considered. In the appendix, a possible schedule for installation is outlined. (UK)

10865 (RL-73-88, pp 159-171) RECENT PROGRESS IN POLARIZED SUBSTANCES. Borghini, M. (CERN, Geneva). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

The latest results on proton polarization are summarized. The substances considered are: ammonia, 1-butanol, 1-pentanol, ethanediol, 1, 2-propanediol, and deuterium hydride. The results on deuteron polarization, $P(D) = \langle I_z \rangle$, obtained in organic compounds are also tabulated. The correlation between P(H), P(D) and P(^{13}C) in samples composed of 1-butanol with H and D, H and ^{13}C and in samples of ethanediol with H, D and ^{13}C, has been studied. It was found that values of P(H), P(D) and P(^{13}C) correspond to equal spin temperatures. Apart from the interest of this result for the solid state physics aspect of dynamic polarization, it has some practical consequences as it allows one to deduce the polarization value of one spin species from the knowledge of another one. Solid ^{3}He has been polarized recently up to 47% in a field of 5.45 T, at temperatures below 5 mK obtained by compressional cooling of liquid ^{3}He, precooled to $\approx$ 30 mK by a dilution refrigerator. (UK)

10866 (RL-73-88, pp 225-248) PROBLEMS IN THE DEVELOPMENT OF LARGE TARGETS. Russell, F. M. (Rutherford High Energy Lab., Chilton, Eng.). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

Background information on the operation of polarized proton targets is given. Based mainly on the availability of microwave components, targets have operated with 8, 4 and soon, 2 mm wavelength microwaves calling for 1.25, 2.5 and 5 Tesla magnetic fields if organic materials are used. The polarisations achievable in the three regimes are roughly equal for a given H/T ratio, increasing somewhat with H. To get acceptable polarizations, say 50%, the three modes call for different types of cryogenic systems, He4, or better, He3 at 2mm, He3 at 4 mm and He3/He4 dilution at 8 mm. Representative curves of power against temperature for the three cryogenic modes are shown. Applying these performance figures to an organic target of 1 litre capacity, to achieve good polarization, $T_o \ll T_{1n}$ at the polarizing temperature and magnetic field strength. For reasonable polarization $T_o/T_{1n,p} \gtrsim 1/3 \equiv F$. The required refrigeration powers for the three modes, with the condition that good polarization is reached in 1 hour, are shown. It is demonstrated that polarization at 0.2 K is not realistic; at 0.5 K it is perhaps possible but expensive, but looks reasonable at 0.8 K in a 5 Tesla field. But with a minimum of 4 Watts of microwave power delivered to the cavity at 2 mm wavelength, more than one carcinotron would be needed. Considering the magnetic field aspects of a large target it is necessary to distinguish between P, A and R measurements in considering the 8, 4 and 2 mm wavelength cases. As expected, the access is better at low fields, though still low, and the magnets for P and R measurements are more expensive than for the A case. Although no attempt has been made to optimize these results, it would appear that a compromise between an expensive and difficult magnet at 5 T with modest cryogenic costs at 0.8 K and a severe cryogenic problem at 0.5 K and 2.5 T might be found if the target were to operate at 3 mm microwaves and 3.7 Tesla. A 5 Tesla magnet would give only small angular access, with large internal forces and large stray fields, but the thought of 2.2 Watts at 0.5 K is equally daunting. (UK)

10867 (RL-73-88, pp 249-258) SOME THOUGHTS ON THE CONSTRUCTION OF LARGE POLARIZED TARGETS. Gamet, R.; Court, G. R.; Hayman, P. J. (Univ. of Liverpool). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

Consideration is being given to the design of a large target (~3 litre) for use on the CERN SPS and in particular for the use of the 200 GeV/c muon beam in the study of inclusive and exclusive reactions. Due to the small cross sections for the reactions and the large cross section of the muon beam at the target, a target of 10 cm × 10 cm cross section and length in the range of 20 to 30 cm is under consideration. Since much of the cost of a polarizing magnet for a polarized target is required in order to provide a very uniform field, the degree of uniformity required is examined. The microwave energy required would be 2 watts dissipated in the target sample at 0.5° K which would cause some refrigeration problems and microwave absorption difficulties. The advantages of a split target are considered. If beams of microwave power were used it would be possible to scan a large target with a relatively small microwave beam. The target would be effectively continuously polarized and maintained at a high level of polarization. The solenoid design is considered. It is concluded that a large polarized target using the microwave scanning principle where a large proportion of the target would be in the frozen spin state is a feasible project for the CERN SPS muon beam. In addition the polarizing magnet in the form of a simple corrected solenoid would provide sufficient access for the investigation of a wide range of semi-inclusive type

processes and would match the acceptance (~15°) of the downstream momentum spectrometers. (UK)

10868 (RL-73-112) LOW EMITTANCE LOW HALO EXTRACTED PROTON BEAM FOR NIMROD. Atchison, F.; Butterworth, J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

The design of a low-emittance low-halo beam channel for Nimrod to satisfy the requirement of a recent proposal to study spin-dependent effects in proton–proton scattering at 8 GeV/c is described. The required emittance has been selected by collimators located so that a low beam halo will accompany the final image. (WHK)

10869 SIMPLE WATER-COOLED TARGET-MOUNTING SYSTEM WITH A SHORT SOURCE-TO-SAMPLE DISTANCE USED ON A 14 MeV NEUTRON GENERATOR. Hermes, E. A.; Pruys, H. S. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen, Switzerland). Nucl. Instrum. Methods; 113: No. 3, 459–460(1973).

A water-cooled target-mounting system is described which can remove 60 W of thermal power concentrated in a beam spot of 4 mm diameter. The sample is 3.8 mm from the beam spot (neutron source). (auth)

10870 POLARIZED PROTON TARGET FOR LOW ENERGY NUCLEAR SCATTERING EXPERIMENTS. Berovic, N.; Clews, C. J.; Maughan, R. L.; Rolph, P. M. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 113: No. 3, 417–422(1973).

A polarized proton target has been constructed and used for scattering experiments with 12 MeV deuterons. The design of the LMN target incorporates new features, which have allowed it to be used successfully at low energies. (auth)

10871 APPARATUS FOR SURFACE MICROANALYSIS BY NUCLEAR REACTIONS WITH AUTOMATIC ENERGY SCANNING. Barcz, A.; Bienkowski, A.; Turos, A.; Wielunski, L.; Zemlo, L. (Inst. of Nuclear Research, Warsaw). Nucl. Instrum. Methods; 113: No. 3, 413–416(1973).

A simple set-up for microanalysis of surface layers by means of nuclear reactions is described. The device considered consists of a reaction chamber with an annular silicon surface barrier detector subtending a solid angle of about 1 sr, and of an electronic circuit allowing automatic measurement of the excitation curves. (auth)

10872 RESPONSE OF A GRAVITATIONAL RADIATION DETECTOR TO MAGNETIC FIELD FLUCTUATIONS. Weber, J. (Univ. of Maryland, College Park); Trimble, V. (Univ. of Maryland, College Park). Phys. Lett., 45A: No. 5, 353–354(22 Oct 1973).

An attempt was made to measure the sensitivity of the Maryland gravitational radiation detector to fluctuating magnetic fields with frequencies of 0.1 to 30 Hertz. No response was found for fields along the cylinder axis and normal to it. For some of the tests, the weakest intensity to which any part of the cylinder was exposed exceeded 100 times the intensity of fluctuations of the earth's magnetic field at these frequencies. (auth)

10873 USE OF SMALL NEUTRON GENERATORS IN SCIENCE AND TECHNOLOGY. Csikai, J. (Kossuth Univ., Debrecen, Hungary). At. Energy Rev.; 11: No. 3, 415–513(1973).

The review outlines the present state of the development of neutron generators and their use in basic physics and technology. The following topics are discussed: principles of operation and output characteristics of neutron generators including the design of intense sources, flux measurements and irradiation arrangements; fundamental nuclear research and neutron data measurements (nucleon-nucleon interaction, total, elastic, non-elastic and reaction cross-sections, radiative capture, fission, nuclear levels and decay schemes); miscellaneous applications of neutron generators (the main fields of activation analysis, well-logging and moisture measurements, reactor physics, safeguards research, irradiation effects in solids, neutron radiography, radiotherapy, neutron attenuation and shielding). (auth)

10874 NEUTRON GENERATING SYSTEMS. Frentrop, A. H. (to Schlumberger Technology Corp.). US Patent 3,775,216. 27 Nov 1973. Filed date 19 Feb 1970. 12p.

A neutron generator tube in which the gas supply is thermally isolated from the ion source by reflective and conductive heat members is described. The conductive heat member is in thermal contact with the tube envelope to permit the envelope to dissipate waste heat from the ion source to an insulating gas (SF_6) in a well logging tool housing. The tool housing also is insulated from an ion source magnet to prevent arcing between the magnet and the tube envelope. (5 claims, 6 drawing figures) (Official Gazette)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 9768, 10273, 10274, 10276, 10999, 11194, 11207, 11225–11231, 11240, 11263, and 11486.

10875 (CONF-710331-) ISOTOPIC COMPOSITION OF THE PRIMARY COSMIC RADIATION. Proceedings of a Symposium, Lyngby, Denmark, March 23–25, 1971. Dauber, P. M. (ed.). (Danish Space Research Institute, Lyngby). 1971. 294p.

Nineteen papers are included on recent measurements of isotopic composition and new technical developments, cosmic-ray propagation and spallation reactions, and astrophysics of possible cosmic-ray sources. (WDM)

10876 (N-73-22747) RADIATION MONITOR COSMIC X-RAY EXPERIMENT OSO-1. Final Project Report. Randall, R. F. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Mar 1973. Contract NAS5-23112. 139p. (NASA-CR-130206). NTIS $9.00.

A comprehensive technical description is presented of the radiation monitor which is part of the GSFC cosmic x-ray experiment to be flown on the OSO-1 satellite. The theory of operation, fabrication and assembly, and cone angle determination are reported. (auth) (STAR)

10877 (N-73-24815) DIFFUSE X-RAY SPECTRUM FROM 14 TO 200 KEV AS MEASURED ON OSO-5. Dennis, B. R.; Suri, A. N.; Frost, K. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1973. 30p. (NASA-TM-X-66252). NTIS $3.50.

The measurement of energy spectrum of the diffuse component of cosmic x-ray flux made on the OSO-5 spacecraft is described. The contributions to the total counting rate of the actively shielded x-ray detector are considered in some detail and the techniques used to eliminate the noncosmic components are described. Positive values for the cosmic flux are obtained in seven energy channels between 14 and 200 keV and two upper limits are obtained between 200 and 254 keV. The results can be fitted by a power law spectrum. A critical comparison is made with the OSO-3 results. Conclusions show that the reported break in the energy spectrum at 40 keV is probably produced by an erroneous correction for the radioactivity induced in the detector on each passage through the intense charged particle fluxes in the South Atlantic anomaly. (auth) (STAR)

10878 (N-73-25848) NEW APPROACH TO COSMIC-RAY DIFFUSION THEORY. Jones, Frank C.; Kaiser, T. B.; Birmingham, T. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1973. 12p. (NASA-TM-X-66263). NTIS $3.00.

An approach is presented for deriving a diffusion equation for charged particles in a static, random magnetic field. The approach differs from the usual, quasi-linear one, in that particle orbits in the average field are replaced by particle orbits in a partially averaged field. In this way the fluctuating component of the field significantly modifies the particle orbits in those cases where the orbits in the average field are unrealistic. The method permits the calculation of a finite value for the pitch angle diffusion coefficient for particles with a pitch angle of 90 rather than the divergent or ambiguous results obtained by quasi-linear theories. Results of the approach are compared with results of computer simulations using Monte Carlo techniques. (auth)

10879 (N-73-26817) RESULTS ON ENERGY DEPENDENCE OF COSMIC-RAY CHARGE COMPOSITION. Balasubrahmanyan, V. K.; Ormes, J. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1973. 16p. (NASA-TM-X-66136). NTIS $3.00.

Measurements using a balloon-borne ionization spectrometer on the differential energy spectra of the heavy nuclei of the galactic cosmic radiation are reported. The spectra of individual elements up to oxygen and groups of nuclei up through iron were measured up to almost 100 GeV/N. The energy spectrum of the secondary nuclei, B + N, is steeper than that of the primary nuclei, C + O, by gamma = 0.21 ± .09 in agreement with other authors. The spectral shapes found are reasonably well represented by single power laws between 2 and 60 GeV/N. Data are consistent with the decrease in the secondary to primary ratio found by others above 20 GeV/N, but it shows no evidence for any sudden change in this ratio within counting statistics. The most dramatic finding is that the spectrum of the iron nuclei is flatter than that of the carbon and oxygen nuclei by 0.57 ± 0.14 power. The experimental techniques for charge and energy determination are presented and corrections due to nuclear disintegration and losses of energy out the bottom of the spectrometer are discussed. (auth)

10880 (NP-19873, pp 93-94) OBSERVATION OF AIR SHOWERS OF ENERGIES ABOVE 10^{17} eV. Kawaguchi, S. (Tokyo Univ.); Suga, K.; Sakuyama, H.; Takano, M.; Uchino, K.; Hara, T.; Ishikawa, F.; Tanahashi, G. 1973.

10881 (NP-19873, pp 124-128) CHACALTAYA EMULSION CHAMBER EXPERIMENT. 1973.

10882 (NP-19873, pp 128-134) STUDY OF MUON SPECTRUM IN THE RANGE OF 10^{12} eV. Takahashi, Y. (Kanazawa Univ.); Shirai, T.; Mizutani, K.; Misaki, A.; Watanabe, Z.; Akashi, M. 1973.

10883 (NP-19873, pp 134-137) OBSERVATION OF SUPER HEAVY COSMIC RAYS USING COMBINED PLASTIC DETECTORS AND X-RAY FILMS. II. Doke, T. (Waseda Univ., Tokyo); Okamoto, H.; Shibamura, E.; Ito, K.; Yanagimachi, T.; Miyajima, M.; Endo, K.; Nagata, K.; Saito, T.; Nishimura, J. 1973.

10884 VARIATION OF THE INTENSITY OF PARTICLES OF ELECTRON–PHOTON SHOWERS IN THE ATMOSPHERE. Guzhavin, V. V.; Ivanenko, I. P.; Paskhalov, Yu. I. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1457-1463 (Jul 1973). (In Russian).

The effect of the meteorological conditions on the passage of particles of electron–photon cascade showers in the atmosphere with variable density was examined. The variation of the intensity of the shower particles of different energies at a given depth in the atmosphere and at different distances from the shower axis was analyzed. Expressions for the barometric and temperature coefficients were reported. (tr-auth)

10885 CALCULATION OF THE FLUCTUATION OF THE CHERENKOV RADIATION OF ELECTRON–PHOTON SHOWERS IN THE ATMOSPHERE. Kol'chuzhkin, A. M.; Uchaikin, V. V.; Bespalov, V. I. (Tomsk Polytechnic Inst., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1442-1446(Jul 1973). (In Russian).

Calculations were made by the Monte Carlo method of the average magnitudes and fluctuations of the number of photons of Cherenkov radiation of electron-photon showers, produced in the atmosphere by primary γ quanta. For some observation altitudes the dependence of the size of the fluctuation on the energy of the primary quanta was obtained in the region $10^8 < E < 10^{11}$ eV. (tr-auth)

10886 CALCULATED CHARACTERISTICS OF THE ELECTRON AND MUON COMPONENTS OF EXTENSIVE AIR SHOWERS AT A LEVEL OF 690 g/cm^2. Popova, L. M. (Inst. of Physics, Sofia). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1439-1441 (Jul 1973). (In Russian).

Calculations were made of the average number of electrons and muons with energy above 5 GeV and of the spatial distribution of the muon density in the vertical shower at a level of 690 g/cm^2. The model of the generation of two fireballs and isobars was used. The dependence $N_\mu \sim N_e^{0.8}$ was obtained. This agrees with the experimental results at Tyan-Shan. The fluctuations of the number of electrons and muons were calculated. (tr-auth)

10887 SPATIAL DISTRIBUTION OF ELECTRONS IN EXTENSIVE AIR SHOWERS IN THE ENERGY RANGE FROM 10^{15} TO 10^{21} eV. Dedenko, L. G.; Dymova, I. A.; Khristiansen, G. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1433-1438(Jul 1973). (In Russian).

The development of nuclear cascades in the atmosphere was calculated using the SKR model. The values obtained for the spatial distribution of electrons are compared with experimental values. (JSR)

10888 RESULTS OF THE INVESTIGATION OF THE RADIOEMISSION OF EXTENSIVE AIR SHOWERS AT FREQUENCIES OF 32 AND 58 Mcps AT THE INSTALLATION OF THE MOSCOW STATE UNIVERSITY. Khristiansen, G. B.; Atrashkevich, V. B.; Vedeneev, O. V.; Prosin, V. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1427-1429(Jul 1973). (In Russian).

The radioemission of extensive air showers at frequencies of 32 and 58 Mcps was investigated of the installation of the Moscow State University. The emission observed agreed with the geomagnetic mechanism of its formation. The averaged spacial distribution functions of both frequencies were similar. At a distance R

from 50 to 180 m from the shower axis the ratio of the field intensity at these frequencies is close to 1 and does not depend on R. (tr-auth)

10889 INSTALLATION FOR THE STUDY OF HORIZONTAL ATMOSPHERIC SHOWERS. Preliminary Results. Volovik, V. D.; Zalyubovskii, I. I.; Ivanov, A. D.; Kaminskii, A. T.; Kartashev, V. M.; Myalitsyn, V. K. (Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1421-1426(Jul 1973). (In Russian).

An installation for the study of horizontal atmospheric showers containing a scintillation control device, hodoscopic gauge, and peripheral hodoscopic section for determination of the shower output was described. The preliminary results obtained with use of this installation are reported. (JSR)

10890 EFFECT OF BOUNDARY PLACEMENT AND THE SPATIAL DISTRIBUTION OF PARTICLES OF EXTENSIVE AIR SHOWERS IN INSTALLATIONS WITH WIDELY SEPARATED DETECTORS. Egorov, T. A.; Kershengol'ts, I. M. (Inst. of Cosmophysics Research and Aeronomy, Yakutsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1411-1414(Jul 1973). (In Russian).

The effect of the boundary of the Yakutsk installation on the precision of the determination of the coordinates of the axis of extensive air showers and on the precision of the determination of the total number of particles were examined. The calculations were carried out by means of drawing simulated showers by the Monte Carlo method. (tr-auth)

10891 EXPERIMENT ON THE STUDY OF COSMIC RADIATION ON THE ARTIFICIAL EARTH SATELLITE INTERKOSMOS-6. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1386-1388(Jul 1973). (In Russian).

An experiment was placed on the Interkosmos-6 which would satisfy the requirements of visual observation of primary particles, determination of the multiplicity of secondary particles produced and their angular distributions, and sufficiently precise and single-valued determination of the charge of primary particles and their energy. This experiment is briefly described. (JSR)

10892 GENERATION OF HIGH ENERGY MUONS IN COSMIC RADIATION. Amineva, T. P.; Varkovitskaya, A. Ya.; Zatsepin, G. T.; Zamchalova, E. A.; Ivanova, M. A.; Mandritskaya, K. V.; Murzina, E. A.; Nikol'skii, S. I.; Osipova, E. A.; Rakobol'skaya, N. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1474-1477(Jul 1973). (In Russian).

The zenith angular distributions of electron–photon cascades of bremsstrahlung γ quanta formed by muons with energy above 2 TeV in lead and registered in an x-ray chamber were reported. A comparison of the experimental distributions with the theoretical showed that cosmic muons of this energy are generated in the decay processes of pions and kaons. (tr-auth)

10893 INTENSITY OF STOPPING MUONS AT DEPTHS OF 60 AND 850 MWe. Alekseev, E. N.; Gurentsov, V. I.; Mikheev, S. P.; Tizengauzen, V. A.; Chudakov, A. E. (Inst. of Nuclear Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1488-1492(Jul 1973). (In Russian).

The experiment for the measurement of the ratio of stopping muons in the scintillation detector to the penetrating muons was described. The measurements were carried out under the earth at depths of 60 and 850 mwe. The measured ratios agree well with the calculated ratios. (tr-auth)

10894 SOME CHARACTERISTICS OF THE MUON COMPONENTS OF EXTENSIVE AIR SHOWERS AT MOUNTAIN TOP LEVEL. Betev, B.; Georgiev, N.; Stamenov, I.; Stanev, T.; Yanminchev, V.; Aseikin, V. S.; Bobova, V. P.; Kabanova, N. V.; Romakhin, V. A. (Inst. of Physics, Sofia). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1484-1487(Jul 1973). (In Russian).

During 1971 to 1972 at the Tyan–Shan installation experiments were carried out on the study of the muon component of extensive air showers. The form of the spatial distribution function of the muon flux with $E_\mu > 5$ GeV was obtained in the interval of distances from 8 to 60 m $\rho_\mu \approx r_\mu - 0.89 \pm 0.04$. The dependence of the number of electrons in the shower $N_\mu \sim N(0.86 \pm 0.04)$. (tr-auth)

10895 EXPERIMENTAL CHARACTERISTICS OF THE MUON FLUX WITH ENERGY >10 GeV IN THE CONSTITUTION OF EXTENSIVE AIR SHOWERS. Il'ina, N. P.; Khrenov, B. A.; Khristiansen, G. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1478-1483(Jul 1973). (In Russian).

Experimental results on the spatial distributions of the muon flux, groups of parallel muons, and the electromagnetic interactions of muons were reported. These data, and data obtained earlier, indicate that near the shower axis the mean function is almost flat. The observation of muon groups near the shower axis is connected with the existence of comparatively young showers in the depths of the atmosphere. (JSR)

10896 ENERGY SPECTRA AND ANGULAR DISTRIBUTION OF COSMIC MUONS AND THEIR GENERATION PROCESSES AT AN ENERGY OF 10^{12} eV. Kirillov–Ugryumov, V. G.; Kirina, T. M.; Kokoulin, R. P.; Pavlov, A. A.; Petrukhin, A. A.; Shestakov, V. V. (Moscow Engineering-Physics Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1493-1497(Jul 1973). (In Russian).

The results of the investigation of the angular and energy distributions of cosmic muons at an energy of 10^{12} eV, carried out on the ionization calorimeter MIFI, were reported. The data did not display any anomalies and within the framework of the accepted picture explained well the generation of muons from the decay of pions and kaons. The contribution of the kaons was determined from an analysis of the two-dimensional distribution. (tr-auth)

10897 SOME PROPERTIES OF A GROUP OF PENETRATING PARTICLES UNDER WIDE ZENITH ANGLES. Bibilashvili, M. F.; Barnaveli, T. T.; Zhukovina, I. A.; Muralova, N. A.; Khaldeeva, I. V.; Eristavi, D. A. (Inst. of Physics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1498-1502(Jul 1973). (In Russian).

The properties of groups of penetrating particles under wide zenith angles (~64° to the vertical), generated by processes of trident formation and by local processes leading to the appearance of high energy groups with relatively large geometric parameters, were investigated and preliminary results were reported. The results led to the conclusion that the energy characteristics of the muon groups in the target is completely confirmed within the limits of the muon component of the extensive air shower. The regularities of the behavior of the majority of the muon high energy triplets and pairs is explained in the limits of trident processes. (JSR)

10898 ENERGY SPECTRA OF THE MUONS OF COSMIC RADIATION AT SEA LEVEL. Varkovitskaya, A. Ya.; Dubrovina, S. A.; Zatsepin, G. T.; Ivanenko, I. P.; Mandritskaya, K. V.; Murzina, E. A.; Nikol'skii, S. I.; Osipova, E. A.; Rakobol'skaya, I. V.; Tulinova, N. I.; Sokol'skaya, N. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1468-1473(Jul 1973). (In Russian).

The energy spectra of cosmic muons obtained by means of x-ray in the energy range from 2 to 20 TeV were reported. It was shown that both the vertical and horizontal spectra of muons at energies of 2 to 7 TeV agree well with the assumptions on the generation of muons in the decay process of π mesons has a power form with the exponent $\gamma_\pi = 1.65$. In the energy interval from 7 to 12 TeV some deficiencies of the number of muons were observed. (tr-auth)

10899 TRANSITION EFFECTS DURING THE REGISTRATION OF THE ELECTRON–PHOTON COMPONENTS OF EXTENSIVE AIR SHOWERS. Ryzhov, V. V.; Samosudov, B. E.; Shoshin, E. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1464-1467(Jul 1973). (In Russian).

Calculations were made of the transition effects arising during registration of the electron–photon components of extensive air showers by scintillation counters and ionization chambers. The calculations were accomplished by the formulas of the perturbation theory with consideration of the particle scattering. The effect of the earth's albedo on these detectors was investigated. (tr-auth)

10900 SOME QUESTIONS OF THE MEASUREMENT OF THE CHERENKOV RADIATION AT THE YAKUTSK STATION FOR EXTENSIVE AIR SHOWERS. Sleptsov, I. E. (Inst. of Cosmophysics Research and Aeronomy, Yakutsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1407-1410(Jul 1973). (In Russian).

The methods for the calibration of the collectors of Cherenkov radiation of extensive air showers at the Yakutsk station were described. The calculations of the radiation loss in the atmosphere because of the molecular scattering were reported. An evaluation was given of the efficiency of the measurement of the total current of Cherenkov radiation of extensive air showers at the Yakat station. (tr-auth)

10901 LARGE TRANSVERSE MOMENTUM AND THE STRUCTURE OF THE CORE OF EXTENSIVE AIR SHOWERS. Aseikin, V. S.; Nesterova, N. M.; Nam, R. A.; Nikol'skii, S. I.; Pavlyuchenko, V. P.; Romakhin, V. A.; Tukish, E. I.; Chubenko, A. P.; Yakovlev, V. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1415-1420(Jul 1973). (In Russian).

An evaluation was made of the contribution of events with large value of $p_\perp h$ ($p_\perp$ is the transverse momentum produced by the cosmic particles during interaction and h is the height of the interaction) and an attempt was made to explain the nature of these events. The analysis showed that with increase of the total number of electrons in the shower the relative contribution of events

with large $p_t h$ increased. From the data obtained the number of events with large transverse momentum increased as expected according to the multiperipheral model and more than expected according to the Planck distribution. (JSR)

10902 STRUCTURE FUNCTIONS OF THE SPATIAL ANGULAR DISTRIBUTION OF PARTICLES OF ELECTRON–PHOTON SHOWERS NEAR THE AXIS. Grzhavin, V. V.; Ivanenko, I. P.; Roganova, T. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1451-1456(Jul 1973). (In Russian).

The effect of the stratification of the medium on the form of the functions of the spatial angular distribution of electrons in electromagnetic cascades of showers was studied. The approximation expressions were obtained for functions of spatial angular distribution of particles in the small angle scattering approximation. The expressions obtained were used for the evaluation of the effect of the size of the gap between absorber and recording layer on the precision of the determination of the energy E_0 of the electromagnetic cascade in the experimental station x-ray film. (tr-auth)

10903 COMMENTS ON FERMI ACCELERATION MECHANISM FOR HIGH-ENERGY COSMIC RAYS. Rengarajan, T. N. (Tata Inst. of Fundamental Research, Bombay). Lett. Nuovo Cim.; 8: No. 14, 861-865(1 Dec 1973).

It is noted that an attractive feature of the Fermi mechanism is the possibility of obtaining a power law spectrum. Modifications to the Fermi mechanism introduced under two realistic situations are computed and it is shown that a single power law does not result. In the first situation, in which the lifetime of the particle is determined by nuclear collisions, it is shown through a rigorous derivation that a single power law does not result. In the second situation, in which particle lifetime is determined by leakage, the spectrum of particles that escape the source is computed instead of the usually computed spectrum of particles that reside in the confinement volume. The implications of these arguments for high-energy cosmic rays are discussed. (LBS)

10904 PHENOMENOLOGICAL STUDY OF COSMIC-RAY PROPAGATION. I. The Nuclei Component. Le Guet, F.; de Freitas Pacheco, J. A. (Universidade de Sao Paulo, Brazil). Astron. Astrophys.; 23: No. 3, 337-346(Mar 1973).

A phenomenological model for cosmic-ray propagation through the Galaxy is considered. The diffusion equation was solved for several nuclei. The actual data are consistent with a flat disk diffusion region which has a radius of about 14 kpc and a half-height of about 2 kpc. (auth)

Stars

Refer also to abstracts 11006, 11092, and 11578.

10905 (N-73-21701) ATTENUATION OF X RAYS EMITTED BY SUPERNOVAE. Schocken, K. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Mar 1973. 12p. (NASA-TM-X-64722). NTIS $3.00.

The attenuation of x rays in Arnett's ^{12}C detonation supernova model is computed. The attenuation of x rays in the filaments of the Crab Nebula is computed using a model for the filaments by Woltjer and a model by Davidson and Tucker. An empirical expression by Gorenstein, Kellogg, and Gursky for the optical thickness of the interstellar medium for three supernova remnants is analyzed. (auth) (STAR)

10906 STELLAR COMPONENT OF THE NIGHTGLOW. Sharov, A. S.; Lipaeva, N. A. (State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 69-74(1973).

Translated from Astron. Zh.; 50: No. 1, 107-114(1973).

The stellar component of the night-sky glow in the B wavelength band is determined from star counts. Corrections are applied to the photometric scales of the catalogs used for the counts, diminishing the estimated sky brightness by a factor of ≈1.5 compared to Roach and Megill's results. The discrepancy between Elsässer and Haug's measurements of the Milky Way surface brightness and Roach and Megill's calculations is thereby removed. It is emphasized that existing estimates of the stellar component at yellow wavelengths also need to be revised. (auth)

10907 EXPERIMENT WITH A PHOTOELECTRIC SPECTROMETER FOR DETERMINING THE ELECTRON DENSITY IN STELLAR ATOMOSPHERES. Karetnikov, V. G.; Korotkikh, T. N.; Medvedev, Yu. A. (University Observatory, Odessa). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 152-153(1973).

Translated from Astron. Zh.; 50: No. 1, 225-227(1973).

Direct spectrum scans obtained with a Seya–Namioka photoelectric spectrometer were measured to determine the characteristics of the line spectra and the possibility of estimating the electron density in the stellar atmospheres. The results indicate that monochromatic radiation should instead be integrated when investigating the line spectra of stars. (auth)

10908 SPECTRAL ENERGY DISTRIBUTION OF SIX STARS. Gusev, E. B.; Komarov, N. S.; Medvedev, Yu. A. (University Observatory, Odessa). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 150-151(1973).

Translated from Astron. Zh.; 50: No. 1, 223-225(1973).

The absolute spectral energy distribution of six stars in the near infrared is reported, as measured with a Seya–Namioka scanning spectrometer. (auth)

10909 ESCAPE OF STARS FROM OPEN CLUSTERS. Danilov, V. M. (Astronomical Observatory, Sverdlovsk, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 145-147(1973).

Translated from Astron. Zh.; 50: No. 1, 217-220(1973).

A method is proposed for calculating the dispersal of star clusters whose members are not of uniform mass. The method uses standard functions for the number-density distribution of stars of differing mass. It is applied to Agekyan's uniform spherical model of a quasisteady-state cluster 3 pc in radius, containing 100 stars. Agekyan's result that two active regions of dispersal exist in such clusters is confirmed. The escape rate is found to be $dN/dt = -0.0858$ star/(10^6 yr), corresponding to complete dispersal of the cluster in $\approx 10^9$ yr. The calculations allow for the influence of mutual encounters of cluster members and for the effect of galactic field stars on the dispersal. (auth)

10910 LUMINOSITY FUNCTIONS OF THE STARS IN THE PRAESEPE CLUSTER. Artyukhina, N. M. (State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 65-68 (1973).

Translated from Astron. Zh.; 50: No. 1, 101-106(1973).

Luminosity functions are derived for stars brighter than 12.5 mpg (Mpg = +6.5 m) in the nuclear and coronal regions of the Praesepe cluster. Possible cluster members brighter than 12.5 mpg are identified from the author's previous proper-motion catalogs. The photographic magnitudes of the possible cluster members are measured. The luminosity functions to Mpg = +6.0 m in the nuclei and coronae of the α Per, Pleiades, and Praesepe clusters are compared. In the nucleus, the Praesepe luminosity function differs considerably from those of the α Per and Pleiades clusters, while in the corona the α Per function is distinct from the similar Praesepe and Pleiades luminosity functions. (auth)

10911 STABILITY OF STELLAR ENVELOPES. Bisnovatyi-Kogan, G. S.; Zel'dovich, Ya. B.; Shakura, N. I. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 369-373(1971).

Translated from Astrofizika; 7: No. 4, 617-624(1971).

The stability of adiabatic envelopes in the external field of the nucleus is investigated. In the case of a rigid nucleus, it is sufficient for the stability of a spherical envelope for the adiabatic index to be $\gamma > 1$. Stability conditions are derived for the envelope in the case of a nucleus whose compressibility is characterized by $\gamma_1 = (\partial \ln P_0/\partial \ln \overline{\rho})_s$, where P_0 is the pressure on the boundary of the nucleus and $\overline{\rho}$ is its mean density. (auth)

10912 QUASIRADIAL PULSATIONS OF ROTATING WHITE DWARFS AND NEUTRON STARS IN NEWTONIAN GRAVITATIONAL THEORY. Papoyan, V. V.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 4, 384-387(1971).

Translated from Astrofizika; 7: No. 4, 643-649(1971).

The frequencies of quasiradial pulsations of rotating white dwarfs and neutron stars are found in the framework of Newtonian gravitational theory. For these models the critical central densities are found, that is, the densities at which stability is lost. It is shown that near the maximal-mass values there is a fairly narrow range of central densities to which there correspond pairs of stable configurations with equal masses but different central densities. (auth)

10913 RELATIVISTIC EFFECTS IN THE FORMATION OF A SHELL DURING THE COLLAPSE OF A ROTATING STAR. Amnuel, P. R.; Guseinov, O. Kh.; Kasumov, F. K. (Astrophysical Observatory, Baku). Astrophysics (Engl. Transl.); 7: No. 4, 388-390 (1971).

Translated from Astrofizika; 7: No. 4, 651-654(1971).

The collapse of a rotating star is investigated. The rotational instability leads to the separation of a shell of small mass from the core. With the relativistic effects taken into consideration, the mass of the shell is less than 4% of the total mass of the star. For the formation of more massive shells it is necessary to invoke other mechanisms. (auth)

10914 NUMBER OF FREE ELECTRONS IN CONDENSED MATTER AS A FUNCTION OF ELECTRON DENSITY. Rezikyan, A. M. (Inst. of Radio Physics and Electronics, Erevan). Astrophysics (Engl. Transl.); 7: No. 4, 391-395(1971).

Translated from Astrofizika; 7: No. 4, 655-662(1971).

The Thomas–Fermi statistical model is employed in calculating the number of free electrons formed in matter with increased electron density. The calculations were performed for a Wigner–Seitz elemental sphere and are valid for densities to $2 \cdot 10^6$ g/cm^3, such as occur in stars ranging up to some white dwarfs. (auth)

10915 VELOCITY VARIATION OF A STAR AS A PURELY DISCONTINUOUS RANDOM PROCESS. II. Massive Stars in Clusters. Kaliberda, V. S.; Petrovskaya, I. V. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 7: No. 4, 396-400(1971).

Translated from Astrofizika; 7: No. 4, 663-670(1971).

The method developed previously for solving the second Kolmogorov–Feller equation is applied to investigate how the velocity distribution function evolves for a group of stars of mass $m_1 = 2\overline{m}$, where $\overline{m}$ is the average mass of a cluster member. The escape rate of these stars is determined, as well as the proportion of energy carried away by the evaporating stars at various epochs. (auth)

10916 NEW Hα-EMISSION STARS AROUND γ CYGNI. Kazaryan, M. A.; Parsamyan, E. S. (Erevan State Univ.). Astrophysics (Engl. Transl.); 7: No. 4, 401-403(1971).

Translated from Astrofizika; 7: No. 4, 671-673(1971).

During the summer of 1970, two photographs of an area of 16 square degrees around γ cyg were obtained. An examination of these plates revealed 35 Hα-emission stars not previously listed. The approximate coordinates, photographic magnitudes, and estimates of the Hα line intensities on a three-point scale are given. (WDM)

10917 LINE FORMATION IN THE PRESENCE OF A MAGNETIC FIELD. III. Zeeman Triplet With Upper Level Not Split: Influence of the Magnetic Field. Domke, H. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Astrophysics (Engl. Transl.); 7: No. 4, 350-362(1971).

Translated from Astrofizika; 7: No. 4, 587-604(1971).

An exact solution is obtained to the problem of the formation of a Zeeman triplet in an isothermal atmosphere, neglecting absorption in the continuous spectrum. The dependence of the H-function on the magnetic-field strength is established for transitions with Doppler and Lorentz frequency profiles. Whatever the profile, the magnetic field has little influence on the H-function (which varies by ≤ 20 to 25%), and the influence of the direction of the magnetic field or of a Faraday-effect correction is far smaller (≤ 2 to 5%). Two approximate methods are suggested for solving problems of line formation in the presence of a magnetic field: a) a finite-field approximation; b) the zero-field approximation. (auth)

10918 CONVECTION IN THE ENVELOPE OF MAIN SEQUENCE A-F STARS. Ergma, E. (Astronomical Council, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 363-365(1971).

Translated from Astrofizika; 7: No. 4, 605-609(1971).

It is shown that the calculated convective velocities in the envelopes of A-F stars are very dependent on the assumptions adopted for the mixing length. Within the framework of the mixing-length theory one cannot obtain an unambiguous solution which would explain some of the physical processes in the stellar envelopes (for example, the generation of acoustic waves, the magnetic field, and so on). It is shown that assumption III is inconsistent within the mixing-length theory since, in this case, $v_{con} > v_s$ is a major part of the envelope. (auth)

10919 FUORS. Ambartsumyan, V. A. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 331-339 (1971).

Translated from Astrofizika; 7: No. 4, 557-572(1971).

The characteristic trait of FU Orions (fuors) is that they suddenly increase their luminosity in the spectral region observed by over a hundredfold within a short time span, after which they retain the enhanced luminosity for extended years. An explanation is offered for this phenomenon, based on the assumption that, prior to the rise in the light-curve in the region directly surrounding the star, there exist energy sources the bulk of whose output is in the form of energy of corpuscular radiation. An envelope encompassing those external sources forms, as indicated by observations, at the time of the rise in brightness. For that reason, almost all of the energy from those sources is emitted, following the rise in brightness, in the form of thermal radiation flux. A parallel is drawn between the differences in the emission of a prefuor and a postfuor, on one hand, and the differences between the emission of fast and slow flares (of flare stars), on the other hand. If this is a valid picture of the reality, slow flares resulting from liberation of energy beneath the photosphere must be radiated in photographic light at a rate 100 times as great as the equivalent (explosive) energy emitted released by fast flares. (auth)

10920 NONCOHERENT SCATTERING. I. Isotropic Scattering. Engibaryan, N. B. (Inst. of Mathematics, Erevan). Astrophysics (Engl. Transl.); 7: No. 4, 340-349(1971).

Translated from Astrofizika; 7: No. 4, 573-586(1971).

A linear problem of radiative transfer in the spectral line in a plane-parallel layer of finite thickness, under general assumptions on the function of redistribution in frequency, independent of the angle of scattering, is considered. The solution of the system of integral equations obtained is reduced to the solution of certain functional equations of Volterra type. Some calculations are carried out in the case of Doppler broadening of the line. (auth)

10921 SLOW FLARE IN PLEIADES. Parsamyan, E. S. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 326-330(1971).

Translated from Astrofizika; 7: No. 4, 547-555(1971).

In the course of observations of Pleiades on the 40″ Schmidt telescope of Byurakan Observatory, one slow and two rapid flares were detected in star No. 103. The rise time to the maximum of the flare was ~40 min and the total duration was about 5 h. The brightness magnitudes and photographs of the flare are shown. A statistical analysis of a number of pre-maximum images of flare stars in Pleiades and Orion, taken with different exposures, was carried out. The slow flare stars in Orion and Pleiades are compared. (auth)

10922 LIGHT CURVE OR A VARIABLE STAR SUBJECT TO ORBITAL TIDAL DISTORTION. Herbison-Evans, D. (Univ., Sydney). Comput. Phys. Commun.; 5: No. 5, 315-327(May 1973).

Given a spectroscopic ephemeris of a double star system suffering tidal distortion, this program finds the inclination of the orbital plane and the γ_1/a ratio (γ_1 = primary star radius, a = semimajor axis of the orbit from the light curve). It also finds the period amplitude, and phase of the oscillation if one of the stars is variable. It also finds the mean brightness of the star and instrumental changes in this value if the star is observed over several years or with different instruments. The program has been used to analyze in this way some observations on α Vis. (WDM)

10923 POPULATION II GIANTS IN THE DDO PHOTOMETRIC SYSTEM. Osborn, W. (Instituto Venezolano de Astronomia, Merida). Astron. Astrophys.; 23: No. 1, 151-152(Feb 1973).

Five extremely metal-poor Population II giants were observed with the David Dunlap Observatory intermediate-band photometric system. It is shown that such stars can be easily recognized by DDO photometry. The effective temperatures and surface gravities of the stars were derived from the observed colors. (auth)

10924 "ZONE OF AVOIDANCE" IN THE PERIOD-AMPLITUDE DIAGRAM OF THE LMC CEPHEIDS. van Genderen, A. M. (Leiden Southern Station, Transvaal, S. Afr.). Astron. Astrophys.; 23: No. 1, 153(Feb 1973).

It is shown that also in the period–amplitude diagram of the LMC Cepheids of Type I a narrow zone exists near log P = 1 in which fewer Cepheids occur than in the adjacent zones of the same width. This phenomenon was already noticed for the SMC, galactic, and M31 Cepheids. (auth)

10925 SELF-SIMILAR ISOTHERMAL FLOW IN GENERALIZED ROCHE MODEL. Ranga Rao, M. P.; Purohit, S. C. (Indian Inst. of Tech., Bombay). Astron. Astrophys.; 23: No. 1, 155-157(Feb 1973).

The self-similar isothermal flow of a gas moving under the gravitational attraction of a central body of fixed mass (Generalised Roche Model) behind a spherical shock wave and propagating in a nonuniform stationary atmosphere was investigated. The numerical solutions were compared with the corresponding solutions for adiabatic flow. (auth)

10926 COMMENTS ON SECULAR STABILITY CRITERIA AND APPLICATIONS. Demaret, J.; Ledoux, P. (Univ., Liege). Astron. Astrophys.; 23: No. 1, 111-116(Feb 1973).

The general and formally exact criterion for secular stability is discussed to point out the interrelation between secular and dynamical stability. Two approximate criteria relating essentially to the stability of stellar nuclear burning are recovered easily from the general criterion. A general relativistic extension of the rigorous criterion shows that supermassive stars cannot be secularly unstable unless dynamical instability has set in previously. In that case, the secular instability is no more than the consequence of the correlation stressed above and cannot be very significant since the dynamical time-scale becomes soon much shorter than the secular time-scale. (auth)

10927 OBSERVATIONS OF OPTICAL NEBULAE AT 2695 MHz. Churchwell, E.; Walmsley, C. M. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 23: No. 1, 117-124 (Feb 1973).

Radio continuum observations at 11 cm of seventeen optically identified nebulae from the Sharpless catalog (1959) are reported. The spectrum is plotted and a discussion of the physical nature of each source is given. The relationship between excitation parameter and spectral type is rederived on the basis of both LTE and non-LTE model atmosphere results and is used to interpret the observations. (auth)

10928 CHROMOSPHERIC HEATING OF VERY HOT STARS BY RADIATION DRIVEN SOUND WAVES. II. Hearn, A. G. (Univ. of Queensland, St. Lucia, Australia). Astron. Astrophys.; 23: No. 1, 97-103(Feb 1973).

An estimate is made of the flux of radiation driven sound waves available for chromospheric heating of very hot stars. The equilibrium energy of radiation driven sound waves propagating in a uniform density atmosphere with viscous damping is calculated and this solution is used to estimate the flux in a star with an effective temperature of 50,000°K (type O5). It is estimated that 8.6×10^7 erg $cm^{-2}s^{-1}$ is available. It appears probable that radiation driven sound waves would give significant chromospheric heating in such a star. This mechanism could explain the formation of emission lines in Of stars and some support for this suggestion is given by recent observations. (auth)

10929 ULTRAVIOLET ABSORPTION BY MOLECULAR HYDROGEN IN STELLAR ATMOSPHERES. Praderie, F. (Institut d'Astrophysique, Paris); Stecher, T. P. Astron. Astrophys.; 23: No. 1, 49-50(Feb 1973).

Quasimolecular absorption by molecular hydrogen in the singlet $X^1\Sigma_g^+ - B^1\Sigma_u^+$ is shown to be a major contributor to opacity in main-sequence A stars at wavelengths shorter than 1600 Å. The importance of this absorber increases for higher surface gravity. This absorption partially masks the Si I photoionization discontinuity at 1520 Å, rendering it less apparent, in accordance with observation. (auth)

10930 H_2CO ABSORPTION AGAINST THE CARINA NEBULA. Gardner, F. F.; Dickel, H. R.; Whiteoak, J. B. (Univ. of Illinois Observatory, Urbana). Astron. Astrophys.; 23: No. 1, 51-54 (Feb 1973).

An investigation of the 6 cm H_2CO absorption against the Carina nebula was made with the Parkes 64 m telescope (4.2′ beam). The optical depths were generally low, but were greatest in two areas where the optical obscuration was high. The formaldehyde results do not contribute significantly to the understanding of the dynamics of the nebula, as revealed by earlier H 109 α observations. (auth)

10931 EVOLUTION OF CONTACT BINARIES AND STAR MODELS FOR CATACLYSMIC BINARIES. Biermann, P. (Universitaetssternwarte, Goettinger, Ger.); Thomas, H. C. Astron. Astrophys.; 23: No. 1, 55-61(Feb 1973).

Calculations of the evolution of contact binary systems are presented. From the observed light curve one can deduce some properties of the common convective envelope. During evolution of the systems mass ratio and period increases. The observed distribution of mass ratios in the color–period diagram is in accord with the picture. In addition some models were calculated for cataclysmic binary systems, consisting of a main sequence star filling its Rochelobe and a white dwarf. The properties of these systems are discussed. (auth)

10932 STUDY OF THE ABUNDANCES OF HEAVY ELEMENTS IN F–G TYPE STARS. I. Differential Analysis of Two Metal Dificient Stars: HR 646 and HR 860. Spite, M.; Spite, F. (Paris Observatory). Astron. Astrophys.; 23: No. 1, 63-68(Feb 1973).

The high information-gathering power of the electronic camera was used to observe (with reciprocal dispersion of 2 Å/mm) the faint lines produced by heavy elements. This enables to determine abundances with precision, since these lines are independent of microturbulence and should be little (if at all) affected by non-LTE effects. The spectra were analyzed differentially (relative to the standard star ν And), and with special effort to obtain the best signal to noise ratio and the best precision. Model atmospheres were derived from the blanketed models of Peytreman. The two first stars analyzed showed a moderate iron deficiency (about −0.30 in logarithm) relative to ν And, and no extra deficiency of heavy elements. Moreover the analysis confirmed that calcium is less deficient than iron and does not contradict that Ti is less deficient and Mn more deficient than iron. (auth)

10933 STELLAR CLASSIFICATION: CALIBRATION IN ABSOLUTE MAGNITUDES. Chalonge, D.; Divan, L. (Institut d' Astrophysique, Paris). Astron. Astrophys.; 23: No. 1, 69-79 (Feb 1973). (In French).

Since the beginning of the new series of spectrophotometrical research described in four papers, the instruments (spectrograph, microphotometer, ...) and methods have been improved and several hundreds of stars were observed and classified in the BCD system. I. From these new data are deduced a more accurate twin-diagram λ_1D for the classification of the stars referred to as "normal", and the following general results: (a) the spectral type can be represented by a measurable parameter s; (b) for any given value of s, the visible gradient Φ_b remains practically constant (independent of luminosity class, within ±0.10); (c) for the late A and F dwarfs, the values of Φ_b for a given spectral type s show some scatter (±0.10 approximately); this scatter seems to be due to the differences of chemical composition between the various "normal" stars. II. The λ_1D diagram has been calibrated in absolute magnitudes for O, B, and the first sub-classes A, from M = 0 to M = −8. (auth)

10934 HIGHLY EVOLVED, LOW-MASS BINARY, HZ 22. Greenstein, J. L. (Hale Observatories, Pasadena, CA). Astron. Astrophys.; 23: No. 1, 1-7(Feb 1973).

The short-period binary, HZ 22 = UX CVn has a small mass function, low total mass, large radial-velocity amplitude and continuous light variation. The invisible secondary is probably a white-dwarf, the primary resembles a normal early B star, with surface gravity near 10^4, T ≈ 28,000°K. There are no emission lines and the spectrum does not vary with phase; the He/H ratio is normal, and the other lines resemble those in τSco. The luminosity of the B star is probably $O \leq M_V \leq +2$, from the space motion, probable mass ($0.13 < m_1/m_\odot < 0.55$), and absence of mass loss at present. The system must have suffered extensive mass exchange, and mass loss. The future life of the B star is very short. The available evolutionary tracks for close binaries suggest how the initially more massive star has become a white-dwarf; the low-mass of the present primary, however, is not explained. Relations with bright blue stars in the halo and globular clusters are discussed. (auth)

10935 RECTIFICATION OF FIVE-COLOR PHOTOMETRY OF LMC SUPERGIANTS. van Genderen, A. M. (Leiden Southern Station). Astron. Astrophys.; 22: No. 3, 467-468(Feb 1973).

It appeared that among the nearly 70 LMC supergiants photoelectrically observed by the author in the Walraven five-color system, ten nonmembers, mostly with high V−B indexes, were involved. Upon removing these nonmembers, the apparent differences between LMC and galactic supergiants largely disappear, although a complete resemblance is not yet proven. (auth)

10936 METALLIC-LINE STAR 15 UMa AND THE F 5 V STAR 5 And. Falipou, M. A. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 22: No. 3, 445-451(Feb 1973).

A detailed model atmosphere analysis is presented for the Am star 15 UMa and the F 5 V star 5 And, assuming LTE. The hydrogen line profiles and the stellar ionization equilibrium indicate that the atmospheres can be represented by a model with: θ_{eff} = 0.71 and log g = 4.2 for 15 UMa and θ_{eff} = 0.81, log g = 3.8 for 5 And. In order to obtain the microturbulent parameter and the abundances, a differential curve of growth analysis was applied, the Sun first, and then 5 And being taken as comparison stars. It is shown that 15 UMa whose line profiles are rotationally broadened is a classical Am star. The results seem to agree with the expected effect of rotation on metallicism and of diffusion process. The comparison star, 5 And, appears to be a slightly metal-deficient star, perhaps a little evolved. (auth)

10937 OBSERVATIONS OF HUBBLE–SANDAGE VARIABLES IN M 31 AND M 33. Rosino, L.; Bianchini, A. (Astrophysical Observatory, Asiago, Italy). Astron. Astrophys.; 22: No. 3, 453-459(Feb 1973).

Eight blue variables of high luminosity (Hubble–Sandage variables), three in M31 and five in M33 were examined on photographs obtained at Asiago for the nova survey after 1953. Light curves are reproduced. Var. 1 in M31 is new, the others have been previously studied by Hubble and by Hubble and Sandage. The general characteristics found by these authors are confirmed by the present material. However, Var. B in M33 has attained in 1963 a maximum of −9.9 B considerably brighter than previously observed. Some considerations follow. (auth).

10938 DISCOVERY OF FIVE NOVAE IN MESSIER 33 AND A SUPERNOVA IN A FIELD GALAXY. Rosino, L.; Bianchini, A. (Astrophysical Observatory, Asiago, Italy). Astron. Astrophys.; 22: No. 3, 461-463(Feb 1973).

Information is given on five novae discovered in the galaxy Messier 33 and a supernova found in a weak galaxy of the field. (auth)

10939 INFRARED SPECTRUM OF THE SUPERNOVA IN NGC 5253. Ciatti, F. (Univ., Padua). Astron. Astrophys.; 22: No. 3, 465-466(Feb 1973).

The infrared spectrum from 6500 to 11,000 Å of the Type I supernova in NGC 5253 is described. An attempt to identify the emission features and a comparison with a Type II supernova are outlined. (auth)

10940 LINE INTENSITIES AND RADIAL VELOCITIES FOR 12 PLANETARY NEBULAE. D'Odorico, S. (Univ., Padua); Rubin, C. C.; Ford, W. K. Jr. Astron. Astrophys.; 22: No. 3, 469-472(Feb 1973).

Image tube spectra of twelve planetary nebulae (NGC 2371-72, 2392, 6818, 6905, 7008, 7026, 7048, IC 2149, IC 5217, Anon 3h50m, 21h31m, 22h54m) were studied to determine relative line strengths (λ 4240 - λ 6731) and radial velocities. (auth)

10941 FEASIBILITY OF uv ASTRONOMY BY BALLOON-BORNE OBSERVATIONS. II. Stellar Gradients in the Near Ultraviolet. Navach, C. (Observatoire de Geneva). Astron. Astrophys.; 22: No. 3, 371-379(Feb 1973).

The analysis of 48 spectrophotometric stellar distributions obtained during a balloon-flight is performed by means of two absolute gradients defined shortward of the Balmer discontinuity. It is found that for normal stars of luminosity classes V, IV, or III the measured stellar fluxes are lower than the predicted fluxes for wavelengths shorter than 3000 Å and for stars of spectral types later than B 5. This effect does not seem to occur for stars of luminosity class II or I. Rapid rotators ($u \sin i \geq 150$ km/s) show a variation of the ultraviolet gradient (a diminution of color temperature) which is at least two times greater than that predicted by theory for spectral types in the range B 1 V-B 5 V. This disagreement between theory and observation disappears for later spectral types. There is the evidence that the anomalous "reddening by rotation" found for earlier spectral types is of the same amplitude in the near uv as in the blue-visible spectral region. (auth)

10942 PHOTOMETRIC STUDY OF 21 COMAE BERENICES. Percy, J. R. (Univ. of Toronto). Astron. Astrophys.; 22: No. 3, 381-383(Feb 1973).

New photometric (B and V) observations of the Ap star 21 Com were obtained at the Kitt Peak and the David Dunlap Observatories. The observations confirmed the 30-minute light variation reported in 1957 by Bahner and Mawridis. The range in V varied from 0.004 to 0.019m and the range in (B - V) was very small. The cause of the variation was probably pulsation; this conclusion is based on the similarity between the properties of 21 Com and the corresponding properties of known δ Sct stars, such as Trumpler 51 in the Pleiades. If this conclusion is correct, then the Ap and Am stars differ in that at least one Ap star pulsates whereas no Am star pulsates. The implications of this difference are discussed briefly. The observations also confirmed the longer-period light variation (period, about a day; range about 0.02m in B and V) noted previously. New photometric observations of two other Ap stars (41 Tau and Hd 32633) showed no evidence for short-period light variations. (auth)

10943 DENSITY SHOCK WAVES DRIVEN BY STAR FORMATION: A MECHANISM. Biermann, P. (Univ.-Sternwarte, Goettingen, Ger.). Astron. Astrophys.; 22: No. 3, 407-412(Feb 1973).

Isothermal self-gravitating flow yields periodic wave solutions only in the subsonic regime (Biermann and Kippenhahn, 1972). Here a mechanism is proposed in which the energy input from H II regions of newly formed stars and energy dissipation from colliding clouds drive a density shock wave that exists exclusively in the gas flow. Star and cloud formation is thought to be initiated by the shock. The mechanism is discussed in the form of a simple numerical model. Some basic properties of the wave, such as length scales and energy balance, relate well with properties of interstellar matter. (auth)

10944 FEASIBILITY OF UV ASTRONOMY BY BALLOON-BORNE OBSERVATIONS. I. Stellar Spectrophotometry. Navach, C.; Lehmann, M.; Huguenin, D. (Observatoire de Geneva). Astron. Astrophys.; 22: No. 3, 361-370(Feb 1973).

Spectrophotometric measurements in the ultraviolet of 48 stars were obtained by an objective prism Schmidt camera flying at 40 km. A description of the payload, the calibration technique and the data reduction process are given. A column density of $(2.42 \pm 0.13) \times 10^{17}$ cm^{-2} for the earth atmospheric ozone present above 40 km is derived from the stellar observations. The intensity distributions of the stars are presented and briefly discussed. (auth)

10945 TWO NEW MAIN-LINE OH IR STARS. Wilson, W. J. (Aerospace Corp., El Segundo, CA); Riegel, K. W. Astron. Astrophys.; 22: No. 3, 473-474(Feb 1973).

The two stars, R LMi and IRC + 20082, were found to have 1667-MHz OH emission. Thirteen other stars were surveyed for 18-cm OH emission with negative results. (auth)

10946 PROPERTIES AND NATURE OF SHELL STARS. III. Periodic Radial-Velocity Changes of 4 Herculis. Harmanec, P.; Koubsky, P.; Krpata. (Ondřejov Observatory, Czech.). Astron. Astrophys.; 22: No. 3, 337-341(Feb 1973).

The radial velocity of shell hydrogen lines of 4 Her measured on Ondřejov and Victoria high-dispersion spectrograms of 1969-1972 was found to vary with a period of 46.023d instead of 0.97625d established by Heard (1940). The original binary hypothesis is revived. (auth)

10947 SECULAR INSTABILITIES OF PURE HELIUM STARS. Osaki, Y.; Hansen, C. J. (Univ. of Colorado, Boulder). Astron. Astrophys.; 23: No. 3, 475-478(Mar 1973).

Models of pure helium stars have been reanalyzed for secular stability. It is found that the degenerate stars on the "high density" branch of the double valued helium main-sequence are secularly unstable, contrary to what was reported in an earlier paper. On the other hand, most stars on the low density branch are secularly stable (but oscillatory for the lowest mode) except two models near the minimum mass, which are oscillatory unstable. A simple explanation for the behavior of eigenvalues along the helium sequence is given using a two-zone model. (auth)

10948 PHOTOELECTRIC OBSERVATIONS OF THE BRIGHT RV TAURI STARS R SCUTI AND U MONOCEROTIS. Wisse, P. N. J.; Wisse, M. (Republic Observatory, Johannesburg). Astron. Astrophys.; 23: No. 3, 463-466(Mar 1973).

Photoelectric observations of the RV Tauri stars R Sct and U Mon are presented. An unusually deep minimum of R Sct and other pecularities in its light and color curves have been observed. U Mon shows a decreasing mean magnitude. A short description of two spectra of R Sct, taken at the Radcliffe Observatory, is given. (auth)

10949 X PERSEI AS A STELLAR X-RAY SOURCE: COMPARISON WITH γ CASSIOPEA. Moffat, A. F. J.; Haupt, W.; Schmidt-Kaler, T. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 23: No. 3, 433-439(Mar 1973).

A series of coudé spectra taken September, 1971 reveals that, except for its large light and V/R variations, X Per has the characteristics of a normal Be star. Its spectral type is 09.5 (III-V)e and there is no detectable veiling. Its somewhat peculiar colors are most likely caused by emission at the Balmer limit. Its absolute luminosity may be somewhat lower (0.7m) than most Be stars of the same spectral type. As opposed to the region surrounding X Per, Giacconi et al. (1972) report no x radiation from the similar, if not more extreme, Be star γ Cas, with spectral type B 0.5 (II-V)e. γ Cas was scanned by the Uhuru detectors five times (X Per only twice) and its apparent optical brightness is 25 times greater than that of X Per. Also both stars had similar V/R ratios (>1) in September, 1971. Thus it is concluded that X Per may not be directly responsible for the x radiation of the source 2U 0352 + 30; however, the data do not exclude a binary model. (auth)

10950 SPECTROSCOPIC STUDY OF MR CYGNI. Hill, G.; Hutchings, J. B. (Dominion Astrophysical Observatory, Victoria, B. C.). Astron. Astrophys.; 23: No. 3, 357-362(Mar 1973).

New spectrographic observations of Mr Cyg have resulted in the determination of a set of spectroscopic orbital elements for the system which are quite different from those previously published. A mass ratio (primary/secondary) $q = 1.81$ and luminosity ratio (same sense) at quadrature ($\lambda = 4150$ Å) $l_P/l_S = 3.5$ were derived from selected high-dispersion plates. The effects of distortion upon the theoretical velocity curve were evaluated and it was found that, in this system, they are significant. By comparing the derived physical parameters with those predicted by evolutionary models of single stars it was found that the components of MR Cyg are slightly evolved "normal" B stars. (auth)

10951 SYMBIOTIC STAR BF CYGNI FROM 1965 TO 1970. Merlin, P. (Observatoire de Lyon). Astron. Astrophys.; 23: No. 3, 363-367(Mar 1973). (In French).

Sixteen spectra of the symbiotic star BF Cygni covering the period 1965-1970 were investigated. Variations of the line intensities, the Balmer decrements, the color, and electronic temperatures are given. Approximate values of the electron density were deduced in order to derive an order of magnitude for the sizes of the emitting regions of BF Cygni. A crude stratification and evolution model is proposed. (auth)

10952 ANALYSIS OF THE LINE SPECTRA OF SOME G AND K Ib SUPERGIANTS. van Paradijs, J. (Univ., Amsterdam). Astron. Astrophys.; 23: No. 3, 369-379(Mar 1973).

The results of an analysis of the line spectra of seven supergiants of type G and K Ib are presented. This analysis is based on observations of line strengths on spectrograms of 1.6 and 6.5 Å/mm, in the wavelength region between 5000 Å, and 6650 Å, and on calculations of weak line strengths for a grid of model atmospheres. Curves of growth were made using solar g f-

values. The supergiants have solar abundances for most elements, except 3 Cet, which shows a general overabundance by a factor of 1.6. Na is overabundant in all the stars, extending the results of Strobel et al. (1970) for late type stars of luminosity class III. Sr and Ba are systematically overabundant, but this effect is neither very large nor very certain. In order to check the result of Bakos (1971) that there is a correlation between the abundances of heavy elements and the luminosity of the star, five early K type giants were analyzed, using the equivalent widths of Cayrel and Cayrel (1963) and of Koelbloed (1972b). No indication of such an effect was found. (WDM)

10953 DYNAMICAL EFFECTS OF STELLAR MASS LOSS ON DIFFUSE NEBULAE. II. Approximate Similarity Solutions. Dyson, J. E. (Univ. of Manchester, Eng.). Astron. Astrophys.; 23: No. 3, 381-385(Mar 1973).

Approximate similarity solutions are calculated to describe the interaction of a high velocity stellar wind with surrounding ambient gas. Calculations are made for three density distributions in the ambient gas. The distributions have the form $\rho \propto r^q$, and $q = 0, -1$ and -2. (auth)

10954 MOLECULAR ABUNDANCES IN STELLAR ATMOSPHERES. II. Tsuji, T. (Observatoire de Paris, Meudon, France). Astron. Astrophys.; 23: No. 3, 411-431(Mar 1973).

Chemical equilibria of 36 elements are solved for the physical conditions of cool stellar atmospheres. It is found that the molecular species formed (monoxide, dioxide, halide etc.) and the degree of molecular association, (i.e. the fraction of atoms locked in molecules) are well correlated with the position of each element (both Group and atomic weight) in the periodic table. In the atmospheres of carbon-rich stars, molecular formation is generally less important than in oxygen-rich atmospheres except for some carbon compounds. The metal oxides in oxygen-rich atmospheres are generally replaced by metal carbides, especially by dicarbides, in carbon-rich atmospheres. The formation of carbides in carbon-rich atmospheres, however, is less effective than that of the corresponding metal oxides in oxygen-rich atmospheres. In carbon stars, it is shown that the Si/S ratio plays a critical role just like the C/O ratio. (auth)

10955 APPROXIMATE EQUATION OF STATE FOR STELLAR MATERIAL. Eggleton, P. P. (Inst. of Theoretical Astronomy, Cambridge, Eng); Faulkner, J.; Flannery, B. P. Astron. Astrophys.; 23: No. 3, 325-330(Mar 1973).

A simple type of formula is described which approximates the Fermi–Dirac integrals for electron density, pressure, and internal energy to about 0.1% or better over the entire range of their arguments; the accuracy depends on the chosen level of approximation. The method can be varied slightly to give thermodynamic quantities which, though only approximate, are entirely consistent thermodynamically (i.e. satisfy Maxwell's relations identically). The method is recommended for the rapid calculation of stellar interiors. A further simple formula is given for a very crude approximation to the effect of pressure ionization on the equation of state in stellar interiors. (auth)

10956 DELTA SCUTI STARS. Baglin, A. (Observatoire de Nice); Breger, M.; Chevalier, C.; Hauck, B.; le Contel, J. M.; Sareyan, J. P.; Valtier, J. C. Astron. Astrophys.; 23: No. 2, 221-240 (Mar 1973).

The extensive observational and theoretical data on δ Scuti variables (published and previously unpublished) are collected and analyzed. Properties of pulsation are discussed, and relationships between δ Scuti stars and other types of pulsators and nonvariable stars are established. (auth)

10957 DIPOLE NEBULA IC 2220, A SOUTHERN REFLECTION NEBULA AROUND THE VARIABLE RED GIANT HD 65750. Dachs, J.; Isserstedt, J. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 23: No. 2, 241-245(Mar 1973).

IC 2220 has been found to be a peculiar butterfly-shaped reflection nebula surrounding the bright variable M 3 III giant HD 65750 = HR 3126. The filaments of the nebula resemble the structure of a magnetic dipole field centered on the red giant. From UBV photometry of the star and the nebula, the (B – V) and (U – B) colors of the nebula are bluer by 0.23m and 0.98m, respectively, than those of the illuminating star. The high ultraviolet excess of the nebula may indicate that the red giant has a faint blue companion which is exciting the nebula, or that the grain properties in reflection nebulae around M-stars and B-stars are different. A very large closed loop which is visible in IC 2220 is tentatively interpreted as a giant prominence originating in the central star. The nebula and its central star possibly have the same distance (375 pc) as the open cluster NGC 2516, which is located only 1.7° from IC 2220 and which contains three more red giants in the helium-burning stage. There is also the possibility that the central star of IC 2220 could still be in its pre-main sequence stage of evolution. (auth)

10958 RELATION BETWEEN OPTICAL SCALE HEIGHT AND DENSITY SCALE HEIGHT IN A STELLAR ATMOSPHERE. van Bueren, H. G. (Astronomical Inst., Utrecht). Astron. Astrophys.; 23: No. 2, 247-252(Mar 1973).

The concept optical scale height was recently introduced by De Jager (1972) and denoted by the symbol θ. In the present paper the optical scale height is expressed in terms of the density scale height H. Whereas this relation depends on the variation of the absorption coefficient with density and temperature, in reasonable approximation a simple proportionality between the two scale heights can be shown to exist, be it in a limited region of optical depth ($10^{-4} < \tau < 0.5$). The proportionality constant has more or less the same numerical value (of order unity) for (visual) continuous as well as for line absorption in a variety of atmospheric models, including the solar model. (auth)

10959 LOW MASS B STARS WITH LOW SURFACE GRAVITY. Trimble, V. (Univ. of California, Irvine). Astron. Astrophys.; 23: No. 2, 281-283(Mar 1973).

A series of static models of stars with inert, isothermal helium cores (X = 0.0; Z = 0.03) and thin hydrogen-burning shells has been calculated. The mass range covered is 0.26 to 0.5 $M_\odot$. All core masses are more than 98% of the total stellar mass. The envelope composition is X = 0.7, Z = 0.03. The models have log T_{eff} from 4.0 to 5.0, log $L/L_\odot$ from 1.4 to 3.6, log g from 1.8 to 5.9, and evolutionary time scales of 10^4 to 4×10^6 years, the last massive evolving most slowly. The sequences of models are a good approximation to evolutionary tracks in the region they cover. A 0.3 to 0.4 $M_\odot$ model will pass through a stage which closely resembles the primary component of HZ 22 in mass, temperature, luminosity, and surface gravity with a time scale of about 10^5 years. (auth)

10960 SECOND BEAT PERIOD IN THE LIGHTCURVE OF SX PHOENICIS. Elst, E. W. (Royal Observatory, Uccle, Belgium). Astron. Astrophys.; 23: No. 2, 285-290(Mar 1973).

From photometric observations of SX Phe by Stock and Tapia (1971) a second beat period of 21.0d is discovered. A formula for maximum light of SX Phe is presented. (auth)

10961 WEAKLY DISTORTED POLYTROPES UNDER EXTERNAL PRESSURE. Horedt, G. Astron. Astrophys.; 23: No. 2, 303-306(Mar 1973).

The stability against radial perturbations of weakly distorted polytropic spheres, cylinders, and rings under external pressure is discussed. Instability occurs for distorted spheres of polytropic index greater than three, having a mass greater than a certain critical value. Polytropic (isothermal) rings and slowly rotating cylinders under external pressure do not show any instability. Relativistic polytropic spheres under external pressure present in the weak field approximation the same kind of instability as the Newtonian spheres. It is shown that polytropic sheets under external pressure are stable with respect to radial perturbations. (auth)

10962 CALCULATION OF HYPERFINE STRUCTURE OF SCANDIUM AND VANADIUM FOR STELLAR SPECTRAL ANALYSIS. Edmunds, M. G. (Observatories, Cambridge, Eng.). Astron. Astrophys.; 23: No. 2, 311-316(Mar 1973).

Recent studies of the effect of hyperfine structure (hfs) on line formation in stellar atmospheres have shown that neglect of hfs can sometimes lead to large overestimates of elemental abundances in spectral analysis. Lack of laboratory data has meant that hfs could only be included in the analysis of a few well-measured lines. An approximate method is presented for the estimation of the hyperfine splitting constant for atoms obeying LS coupling, which will allow the inclusion of hfs in the analysis of many more lines than was previously possible. This method is applied to certain low-lying terms of scandium and vanadium, and comparison with published laboratory data indicates that the electron configuration assignment of some of these terms should be revised. (auth)

10963 STUDY OF Ca II K_2 AND H_α LINE WIDTHS IN LATE TYPE STARS. Reimers, D. (Institut fuer Theoretische Physik, Kiel). Astron. Astrophys.; 24: No. 1, 79-87(Apr 1973).

In addition to the well known relation between the Ca II K emission width W_0 and the visual absolute magnitude M_v (Wilson and Bappu, 1957) it is shown that W_0 varies with the more fundamental parameters gravity g and effective temperature T_e as $W_0 \sim g^{-0.2} \cdot T_e^{1.1}$. The widths of photospheric weak lines—essentially due to macroturbulence—and the microturbulent velocities in cool stars seem to behave in a similar way. The Wilson–Bappu effect presumably represents a fundamental property of turbulent velocities in the atmospheres of late type stars. It is further shown that the

ratio of the line widths of H_α and Ca II K_2 is a mere function of gravity. A curve of growth study of this ratio provides approximate stellar chromospheric densities, turbulent velocities, and an estimate of the excitation temperature of the second quantum level of hydrogen. The influence of metal abundance on the Wilson–Bappu relation is explained theoretically. A new method is proposed to estimate the mass ejection of red giants using the violet displacements of the emission component of Ca II K. The results agree with those obtained by Deutsch (1960) and others from circumstellar lines. (auth)

10964 CORRELATION BETWEEN THE MAGNITUDE AND THE RADIAL VELOCITY OF HOT STARS. Lefevre, J. (Observatoire de Nice). Astron. Astrophys.; 24: No. 1, 99-101(Apr 1973).

The difference between mean apparent magnitudes for B stars with a positive particular radial velocity and for B stars with a negative one is shown to be due to the nearby stars and does not prove the existence of dust in front of hot stars. (auth)

10965 NUCLEAR REACTIONS IN CARBON STARS. Gelinas, A.; Tassoul, M.; Beaudet, G. (Univ. of Montreal). Astron. Astrophys.; 24: No. 1, 111-120(Apr 1973).

The aim of the present work is to determine the effect on stellar evolution of the network of reactions that can take place during carbon burning. Initial models of low-mass stars ($0.8\ M_\odot < M < 1.25\ M_\odot$) with a homogeneous composition ($C^{12}:O^{16} = 1$ by mass) are considered. At the lower limit, combustion can take place in a convective core only, whereas for the other models, this phase is followed by nuclear shell burning. The results can be summarized as follows: (a) Roughly speaking, the last models computed (approaching the white dwarf stage) have the following central composition: $O^{16}:0.43$; $Ne^{20}:0.30$; $Ne^{21}:0.02$; $Ne^{22}:0.01$; $Na^{23}:0.08$; $Mg^{24}:0.16$. (b) For the other elements, the final abundances are quite sensitive to the mass of the star considered, and are different from those that would obtain with an isothermal combustion, as given by Arnett and Truran (1969). (c) Even at the end of the evolution, the effect of convection is still noticeable: for every element, there is a sharp variation at the last shell reached by the convective core. (auth)

10966 NEBULAR STAGE OF NOVA DELPHINI 1967. I. Malakpur, I. (Institut d'Astrophysique, Paris). Astron. Astrophys.; 24: No. 1, 125-130(Apr 1973). (In French).

The nebular stage of Nova Delphini 1967 was studied for the period from December 1968 to June 1970. It is shown from the profile of the emission lines that the envelope of the Nova consists of two polar caps and two equatorial rings, and that the Nova may be an eclipsing binary. Using the lines of [O III] and [N II], the values of N_e and T_e are calculated and it is shown that there is a continuous increase of T_e and a continuous decrease of N_e with respect to time. N_e was determined by the method of surface luminosity and it was found that N_e is 2.70 times less than calculated using the forbidden lines. A mass of the order of $3.3 \times 10^{-4}\ M_\odot$ for the envelope was calculated. (auth)

10967 PHOTOELECTRIC LIGHT CURVE OF THE ALGOL SYSTEM TW ANDROMEDAE AND THE INTERPRETATION OF ITS DISTORTIONS BY THE EFFECTS OF HOT SPOTS. Ammann, M.; Walter, K. (Univ. of Tuebingen, Ger.). Astron. Astrophys.; 24: No. 1, 131-142(Apr 1973).

Photoelectric observations in B and V of this semi-detached Algol system obtained in 1965-1970 are discussed. In distinction to the usual method of treatment of observations, the parameters of rectification were derived only from those parts of the light curves which, according to recent ideas on gas streams in Algol systems, could be assumed to be clear of the influences of them. As soon as the light curve outside of eclipses had been freed from the effects of reflection and ellipticity in this way, there remained systematic distortions which could be explained by the existence of an additional light source of about 3% of the intensity of the uneclipsed system. This light source is situated on the bright F-component at high latitudes in front of the subgiant. It disappears twice during one period of revolution of the system: once while it is hidden by the F-star itself for about one half of the period, and for a second time within the course of the primary eclipse. The B- and V-observations could be represented satisfactorily by the same geometrical parameters of the system. Light from a third star is present. (auth)

10968 YOUNG GALACTIC CLUSTER NGC 3766. Winnenburg, W. (Univ., Muenster, Ger.). Astron. Astrophys.; 24: No. 1, 157-159(Apr 1973).

The southern galactic cluster NGC 3766 was studied by means of the UBV photometry using plates taken with the ADH telescope of the Boyden Observatory. The following results were found: apparent diameter 12′, color excess $E_{B-V} = 0.16$m, apparent distance modulus 11.4m. With an interstellar absorption of 0.48m the true distance modulus was estimated to be 10.9m, corresponding to a distance of 1530 pc; the linear diameter is consequently 5.3 pc. By using different methods the age was found to be less than 3×10^7 years. These results fit the Becker diagram of spiral arms very well. (auth)

10969 SECULAR STABILITY. V. The Perturbation of Chemical Abundances. Aizenman, M. L. (Univ. of Montreal); Perdang, J. Astron. Astrophys.; 23: No. 2, 209-214(Mar 1973).

Calculations of the secular stability of stars near the main sequence were modified to include perturbations of chemical abundances. It was found that these perturbations give rise to an additional spectrum which appears to be continuous. The usual secular spectrum is practically unchanged from the one obtained when abundance perturbations are neglected. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 10949, 11077, and 11078.

10970 (N-73-24831) SCO X-1: ORIGIN OF THE RADIO AND HARD X-RAY EMISSIONS. Ramaty, R.; Cheng, C. C.; Tsuruta, S. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1973. 31p. (NASA-TM-X-66244). NTIS $3.75.

The consequences of models for the central radio source and the hard x-ray (> 30 keV) emitting region in Sco X-1 are examined. It was found that the radio emission could result from noncoherent synchrotron radiation and that the x rays may be produced by bremsstrahlung. It is shown that both mechanisms require a mass outflow from Sco X-1. The radio source is located at $r \sim 3 \times 10^{12}$ cm from the center of the star, and its linear dimensions do not exceed 3×10^{13} cm. The magnetic field in the radio source is on the order of 1 gauss. If the hard x rays are produced by thermal bremsstrahlung, their source is located at $10^9 \lesssim r \lesssim 5 \times 10^9$ cm, the temperature is 2×10^9 K, and the emission measure is 2×10^{56}/cu cm. This hot plasma loses energy inward by conduction and outward by supersonic expansion. The rates of energy loss for both processes are about 10^{36} erg/s, comparable to the total luminosity of Sco X-1. (auth) (STAR)

10971 APERTURE-SYNTHESIS INTERFEROMETER AT OOTY FOR OPERATION AT 327 MHz. Swarup, G.; Bagri, D. S. (Tata Inst. of Fundamental Research, Bombay). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1285-1287(Sep 1973).

A 3.5-km long interferometer consisting of the 530 by 30 m Ooty radio telescope, two 13.5-m diameter dishes, and a 5-m diameter dish are described. For generating coherent local-oscillator signals for the interferometer, a simple phase-stable radio link has been developed which uses the sum-frequency method proposed for the VLA antenna. The interferometer, expected to be in operation in 1973, will provide a resolution of about 0.8×5.5 arc at 327 MHz and will be able to detect a radio source of flux density 2×10^{-28} $W \cdot m^{-2}\ Hz^{-1}$ with a S/N ratio of 5 to 1. A proposed 10-km long synthesis interferometer consisting of the Ooty telescope and 36 dishes of 5-m diameter is also described. At 327 MHz, this instrument will provide beamwidths of 15″ by 30″ arc and 15″ by 20″ arc at declinations of 0° and 30°, respectively. It will have a sensitivity of about 10^{-28} $W \cdot m^{-2}\ Hz^{-1}$ for a 9.5-h observing period. (auth)

10972 100-METER RADIO TELESCOPE AT EFFELSBERG. Hachenberg, O.; Grahl, B. H.; Wielebinski, R. (Max-Planck-Institut fuer Radioastronomie, Bonn). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1288-1295(Sep 1973).

The 100-m fully steerable radio telescope of the Max Planck-Institut für Radioastronomie (MPIfR) has now been in service for over a year. The telescope was designed to allow observations in the decimeter and centimeter wavelength regions, with the vastly improved resolution given by the 100-m diameter. During construction of the telescope measurements were made at a wavelength of 75 cm. Since the completion of the adjustments, tests and observations were made at 11-cm and 2.8-cm wavelength. In particular, at the 2.8-cm wavelength, tests have fully confirmed the design goals. In fact it is hoped to extend the operational range of the telescope at least to the wavelength of 1.2 cm. A number of problems, new in this field, had to be solved in the construction of an instrument of this size and precision. Measuring methods are described which allowed adjustment of the surface to ±1 mm. A computer-controlled servo loop allows setting of the telescope to 5″. Experience of operation under various conditions is described. (auth)

10973 PULSAR RECEIVERS AND DATA PROCESSING. Taylor, J. H. (Univ. of Massachusetts, Amherst). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1295-1298(Sep 1973).

The rapid variability of pulsar signals and the dispersive nature of the interstellar medium introduce a number of problems which are not inherent in other radio-astronomical observations. These problems are discussed and some of the techniques currently being used to cope with them are described. (auth)

10974 LONG WAVELENGTH VLBI. Clark, T. A. (Goddard Space Flight Center, Greenbelt, MD); Erickson, W. C. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1230-1233(Sep 1973).

The application of very-long baseline interferometry (VLBI) techniques at meter and decameter wavelengths has proven to be a unique tool for studying a number of different phenomena. Because of the high angular resolution achieved with VLBI, candidate objects for study include the compact nuclei and "jets" associated with quasars and radio galaxies, pulsars, small knots in galactic supernova remnants, and nonthermal planetary sources. Investigations have been aimed at determining the emission spectra of these objects, measuring their apparent angular size, and mapping their structure. It is expected that these properties will be interrelated, particularly at or below the frequencies at which their spectra peak. As various components of a radio source become self-absorbed the apparent angular structure must change quite radically. Concomitant investigations of transmission properties of the various media which intervene between the source and the observer must be carried out. Often these investigations of the interstellar, interplanetary, and ionospheric media are as interesting as the study of the radio sources themselves. (auth)

10975 SPECTRAL-LINE ANALYSIS OF VERY-LONG-BASELINE INTERFEROMETRIC DATA. Moran, J. M. (Smithsonian Institution, Cambridge, MA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1236-1242(Sep 1973).

Several topics concerning the processing and interpretation of data obtained with very-long-baseline (VLB) interferometers—i.e., tape-recorder interferometers—from spectral-line radio sources are discussed. The instrumental phase shifts are traced through the interferometer. The spectral resolution and normalization of the visibility spectrum are discussed. Expressions for estimating fringe amplitude, and the associated signal-to-noise ratio, are derived for the case when the integration time exceeds the coherence time of the interferometer. Procedures are presented for measuring the relative spatial distribution of a widely separated collection of point sources utilizing fringe-phase data and rate of change of fringe-phase data. (auth)

10976 NRAO TAPE-RECORDER INTERFEROMETER SYSTEM. Clark, B. G. (National Radio Astronomy Observatory, Charlottesville, VA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1242-1248(Sep 1973).

Several tape-recorder interferometer systems have been constructed in the last few years. These systems are used for connecting existing radio-telescope systems into interferometers, with baselines ranging from a few kilometers to nearly the diameter of the earth. The NRAO Mark II interferometer system is in wide use. This, and the fact that its properties are typical of those of such systems in general, justifies a detailed description of the system. The system is based on a television-type rotating-head video recorder. One-bit sampled data are recorded at a 4-Mb rate. After recovery, the data are processed in special-purpose digital devices and general-purpose digital computers to complete the interferometer system. For purposes of this description, the software is regarded as an intrinsic part of the system. (auth)

10977 STANFORD FIVE-ELEMENT RADIO TELESCOPE. Bracewell, R. N. (Stanford Univ., CA); Colvin, R. S.; D'Addario, L. R.; Grebenkemper, C. J.; Price, K. M.; Thompson, A. R. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1249-1257 (Sep 1973).

The Stanford radio telescope array is a fast image-forming interferometer using Earth rotation synthesis to produce a brightness map of the continuum radiation from a portion of the sky using data obtained in one 10-h observation. The array consists of five 18.3-m diam paraboloid antennas mounted on an east–west line in such a way that pairs of antennas span all spacings from 1 to 9 times the unit spacing of 22.9 m. At the operating wavelength of 2.8 cm (10,690 MHz) the half-peak beamwidth is 18.8″ and the grating-lobe spacing is 4.2′, both in the east–west direction. The antennas, are equatorially mounted and have a range of motion in declination from the south horizon to the north pole and in hour angle from horizon to horizon or ±5 h, whichever is less. Both hour angle and declination motions are controlled by chain-drive mechanisms. (WDM)

10978 SYNTHESIS RADIO TELESCOPE AT WESTERBORK. Baars, J. W. M.; Van Der Brugge, J. F.; Casse, J. L.; Hamaker, J. P.; Sondaar, L. H.; Visser, J. J.; Wellington, K. J. (Netherlands Foundation for Radio Astronomy, Radio Observatory, Dwingeloo). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1258-1266(Sep 1973).

The synthesis radio telescope (SRT) is an array of 20 simultaneous interferometers formed by 10 fixed and 2 movable antennas on an E–W baseline of 1600 m, operating on the principle of rotational aperture synthesis. It is capable of observing continuum radiation in 4 Stokes parameters and line radiation at 50-, 21-, and 6-cm wavelengths. This paper centers on a description of the electronic system with emphasis on those features by which its exceptional stability has been realized. Included are sections on the mechanical construction and adjustments, the data processing, and some examples of astronomical results. (auth)

10979 NEW SOUTHERN HEMISPHERE SYNTHESIS RADIO TELESCOPE. Christiansen, W. N. (Univ. of Sydney). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1266-1270(Sep 1973).

An Earth-rotational synthesis radio telescope is now operating at a wavelength of 21 cm at Fleurs, near Sydney, Australia. The telescope produces a map of a 1.5 square-degree region of sky in an observing time of 12 to 16 h. In the first stage the resolution is 40″ and the sensitivity (5 times rms noise fluctuations) is about 70×10^{-26}. A full range of scanning angles is available for mapping sources between declinations 80°S and 30°S, but mapping of a lower quality is possible at lower declinations. The telescope consists of two independent arrays used consecutively. One is in an east–west line and the other is in a north–south line. Each consists of two 13.8-m-diam paraboloids and thirty-two 5.8-m paraboloids arranged as a compound grating interferometer. The paraboloids track a source for 8 h and the phases of signals from each paraboloid are rotated continuously to compensate for the movement of the source across the sky. 64 cosine and 64 sine Fourier components of the brightness distribution over the source are extracted simultaneously and each is recorded every minute. After an observation of several hours, a digital computer makes the necessary transformations and produces a map. (auth)

10980 SUPERSYNTHESIS RADIO TELESCOPE FOR NEUTRAL HYDROGEN SPECTROSCOPY AT THE DOMINION RADIO ASTROPHYSICAL OBSERVATORY. Roger, R. S.; Costain, C. H.; Lacey, J. D.; Landecker, T. L.; Bowers, F. K. (National Research Council of Canada, Penticton, B. C.). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1270-1276(Sep 1973).

A radio telescope designed for studies of the 21-cm line of neutral hydrogen is described. It combines the techniques of aperture synthesis and digital correlation spectrometry to achieve an angular resolution of 1 arc min within an area of sky of 2° diameter and a frequency resolution variable from 3 to 100 kHz with 80 channels. The telescope comprises four 9-m paraboloids, two fixed and two movable on a 300-m precision E–W track. The system noise is 80°K. Remote local oscillators are controlled in phase to about 1 degree independent of the electrical lengths of distributing cables. An on-line computer provides source positions, and controls telescope tracking, local-oscillator frequency and phase, and incremental delay compensation. It also performs the Fourier transformation of the correlation coefficients and the data logging. The digital correlator uses 3 by 5 level quantization which reduces signal-to-noise degradation due to quantization to a factor 1.16. The telescope sensitivity for emission and absorption studies is discussed and first results are presented. (auth)

10981 CLARK LAKE ARRAY. Erickson, W. C. (Univ. of Maryland, College Park). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1276-1277(Sep 1973).

A powerful new instrument for meter and decameter wavelength radio astronomy is described. It will soon be available for both solar and sidereal studies. (auth)

10982 HAT CREEK MILLIMETER-WAVE INTERFEROMETER. Hills, R. E.; Janssen, M. A.; Thornton, D. D.; Welch, W. J. (Univ. of California, Berkeley). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1278-1282(Sep 1973).

A fixed-baseline millimeter-wave interferometer, operating initially at 13.5 mm, has been put into operation at the Hat Creek Observatory as the first step in the development of a two-element aperture synthesis telescope. The first system consists of a 3-m antenna and a 6-m antenna spaced 265 m apart. Large receiver bandwidths may be used at high frequencies, and this system employs an intermediate frequency bandwidth of about 400 MHz. It also has automatic gain control and a phase stabilized local-oscillator reference cable. Observations may be made either in the continuum or with a 128-channel spectrometer. The baseline vector has been obtained from observations of about 7 QSO's. The instrument has been used to derive accurate absolute positions of interstellar water vapor sources, to study Mercury, Venus, and Mars, and to make crude maps of a few complex continuum

sources. Measurements of the interferometer phase fluctuations due to the atmosphere indicate that interferometry is possible under average weather conditions at Hat Creek at wavelengths as short as 2 mm. The synthesis telescope, the next stage, has two 6-m antennas which can be located at various stations on a T-shaped track. The east-west leg is 300 m and the north-south leg is 200 m, permitting full synthesis for sources on the equator and at declinations as low as −30° as well as at high declinations. Operation at wavelengths down to 2 mm will be possible with resolution of 1 to 2″. (auth)

10983 EARTH-ROTATION APERTURE SYNTHESIS. Fomalont, E. B. (National Radio Astronomy Observatory, Greenbank, WV). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1211-1218(Sep 1973).

Resolution for radio astronomy in the order of 1″ is necessary for the study of distant radio galaxies and quasars, for detecting faint sources, and for the mapping of clouds of hydrogen and other molecules. To obtain these resolutions many new or planned radio instruments use arrays of moderate size radio telescopes to synthesize large physical apertures. These instruments are generally composed of one or several linear arrays and utilize the rotation of the Earth to change the relative orientation of the array and the radio source. The techniques used for Earth-rotation aperture synthesis are discussed. The response of a two-element interferometer and the geometry associated with Earth-rotation synthesis are reviewed; the current and proposed designs for these instruments and their performance are described; and, finally, the inversion methods for determining the angular power distribution of a radio source from the array response (visibility function) are outlined. (auth)

10984 VERY-LONG-BASELINE INTERFEROMETRY TECHNIQUES APPLIED TO PROBLEMS OF GEODESY, GEOPHYSICS, PLANETARY SCIENCE, ASTRONOMY, AND GENERAL RELATIVITY. Counselman, C. C. III. (Massachusetts Inst. of Tech., Cambridge). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1225-1230(Sep 1973).

Very-long-baseline interferometry (VLBI) techniques have already been used to determine the vector separations between antennas thousands of kilometers apart to within 2 m and the directions of extragalactic radio sources to 0.1″, and to track an artificial satellite of the earth and the Apollo Lunar Rover on the surface of the Moon. The relative locations of the Apollo Lunar Surface Experiment Package (ALSEP) transmitters on the lunar surface are being measured within 1 m, and the Moon's libration is being measured to 1″ of selenocentric arc. Attempts are under way to measure the solar gravitational deflection of radio waves more accurately than previously possible, by means of VLBI. A wide variety of scientific problems is being attacked by VLBI techniques, which may soon be two orders of magnitude more accurate than at present. (auth)

10985 PROPERTIES OF PULSARS. Manchester, R. N. (Univ. of Massachusetts, Amherst). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1205-1211(Sep 1973).

The principal observed properties of pulsars and their theoretical interpretation are reviewed. (auth)

10986 INTRODUCTION TO VERY-LONG-BASELINE INTERFEROMETRY. Cohen, M. H. (California Inst. of Tech., Pasadena). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1192-1197(Sep 1973).

Long-baseline interferometry achieves high angular resolution by using two or more widely separated radio telescopes and recording video signals on magnetic tapes, which are later brought together and cross-correlated. This paper contains discussions of the coherence and timing requirements and of calibration procedures. Applications to measuring brightness distributions and to spectroscopy are reviewed briefly. Some pertinent phenomena connected with radio-wave scattering in irregular media are discussed. (auth)

10987 NEUTRAL HYDROGEN AND GALACTIC STRUCTURE. Kerr, F. J. (Univ. of Maryland, College Park). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1182-1192(Sep 1973).

Observations of the 21-cm line of neutral hydrogen give the best method for mapping the spiral structure of the Galaxy, but there are still difficulties of interpretation. These arise from the need to infer the distance of any hydrogen concentration from its radial velocity, under circumstances where the velocity field and the structural pattern must both be derived from the same observations. The role of the density-wave theory of spiral structure is discussed. In addition to the mapping problem, this paper also considers the general properties of the galactic disk, the galactic center region, normal and high-velocity hydrogen clouds, and some aspects of hydrogen in other galaxies. (auth)

10988 EXTRAGALACTIC RADIO SOURCES. Kellermann, K. I. (National Radio Astronomy Observatory, Greenbank, WV); Pauliny-Toth, I. I. K. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1174-1182(Sep 1973).

More than 10,000 individual discrete sources have been detected by radio surveys made at frequencies from 10 MHz to 5 GHz. Although only a few hundred of these are reliably identified with galaxies or quasars, it is widely believed that the overwhelming majority are extragalactic. As a result of the rapid improvement in the sensitivity and the resolution of radio telescopes, the coordinates of many of the cataloged sources are being routinely measured with an accuracy of about 1″ and with special effort to a few tenths of a second of arc. Their angular structure is being mapped with a resolution of a few arc seconds by means of sophisticated multielement interferometer arrays; and for the very bright sources, tape recording interferometers with continental and intercontinental baselines give a resolution three or four orders of magnitude better. The form of the radio frequency spectra is known in some detail between 38 MHz and 10 GHz for hundreds of sources, and for a smaller number from 10 MHz to 100 GHz. Yet, in spite of the many exciting new observational results, or perhaps because of them, many more problems in understanding the extragalactic sources have arisen than have been answered by the more recent observations. (auth)

10989 DIGITAL CORRELATION SPECTROMETER EMPLOYING MULTIPLE-LEVEL QUANTIZATION. Bowers, F. K. (Univ. of British Columbia, Vancouver); Whyte, D. A.; Landecker, T. L.; Klingler, R. J. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1339-1343(Sep 1973).

The correlation of quantized signals yields a lower signal-to-noise ratio than analog correlation by a factor D. The dependence of D on number and spacing of quantization levels, and on quantization rate is shown. A digital cross correlator is described which multiplies the signals from two antennas of a synthesis telescope. One signal is quantized into 5 levels and the other into 3 levels. D = 1.16, a significant improvement over a 2-level correlator where D = 1.57, with little increase in complexity. The complex crosscorrelation function of the input signals is generated for 125 delay values, with overall bandwidths of 0.25-8 MHz. Special channels of the correlator monitor signal power and quantizer performance. (auth)

10990 PULSARS AS PROBES OF THE INTERSTELLAR MEDIUM. Guelin, M. (Observatoire de Paris, Meudon, France). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1298-1302 (Sep 1973).

Pulsar observations offer an opportunity to determine the distributions of the magnetic field, electron density, and neutral atomic hydrogen density in the interstellar space. Pulse polarization and time of arrival measurements indicate a relatively uniform magnetic field of about 3 μG, whereas new distance measurements through 21-cm line absorption indicate an electron density of about 0.03 cm^{-3} which is uniform when averaged over large distances (a kiloparsec or more). (auth)

10991 CALCULATION AND A PRELIMINARY INTERPRETATION OF OBSERVED SPECTRA OF THE GASEOUS FILAMENTS IN THE CRAB NEBULA. Golovatyi, V. V.; Pronik, V. I. (Astronomical Observatory, Lvov). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 135-136(1973).

Translated from Astron. Zh.; 50: No. 1, 208-209(1973).

Spectra are calculated for various models of the Crab Nebula filaments. One model provides good agreement between the computed spectrum and the observed spectrum averaged over all the filaments. An attempt is made to explain the observed distinctions between the spectra of different filaments. (auth)

10992 DISCOVERY OF VARIABLE CIRCULAR POLARIZATION IN THE OPTICAL RADIATION FROM X-RAY STAR SCO X-1. Gredin, Yu. N.; Shulov, O. S. (Ioffe Inst. of Physics and Tech., Leningrad). Astrophysics (Engl. Transl.); 7: No. 4, 317-325(1971).

Translated from Astrofizika; 7: No. 4, 529-545(1971).

During 14 nights, from June 23 to July 28, 1971, polarimetric observations of Sco X-1 were conducted, and circular polarization was discovered in its yellow–red optical radiation. The amount of polarization oscillates about the zero point and, in its variations, there are two oscillatory processes with periods P_1 and $P_2 = P_1/2$. The mean amplitudes p_1 and p_2 are of the order of 1%, with $p_2 = \sqrt{p_1}$. Both the periods and the amplitudes depend on the star's brightness. It may be thought that the optical radiation of Sco X-1 consists of two components: radiation from a starlike object (visual brightness $15^m < m_V \leq 17.7^m$) and radiation from an optically thick magnetoactive plasma envelope surrounding the object. The circular polarization results from the scattering of the starlike object's radiation in its envelope. The magnetic-field strength in the envelope is estimated to be $H \geq 2 \cdot 10^7$ G. (auth)

10993 NATURE OF THE RADIO WAVELENGTH EMISSION FROM PULSARS. Yukhimuk, A. K. (Inst. of Geophysics, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 366-368(1971).

Translated from Astrofizika; 7: No. 4, 611-615(1971).

The radiation mechanism of a rotating and pulsating neutron star is considered. It is suggested that the radiation might be caused by the movement of relativistic electrons in spiral orbits along magnetic field lines emerging from the poles. It is shown that relativistic effects in a multiscrew stream lead to the appearance of instability and to the generation of electromagnetic radiation in the frequency range $\omega_{He}/(1+\beta_{||}) < \omega < \omega_{He}/(1-\beta_{||})$, where $\beta_{||} = v_{||}/c$, $v_{||}$ is the velocity of the particles parallel to H and c is the velocity of light. (auth)

10994 136-MHz/400-MHz RADIO-SKY MAPS. Taylor, R. E. (Goddard Space Flight Center, Greenbelt, MD). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 4, 469-472(Apr 1973).

A radio-sky map, covering the whole celestial sphere, is helpful for determining the system noise temperature of an Earth-based satellite receiving system. Detailed sky maps for the 136- and 400-MHz space research (space-to-earth) satellite frequency bands have been generated, using a computer, by the National Aeronautics and Space Administration (NASA). (auth)

10995 ASTRONOMICAL PUZZLE CALLED CYGNUS X-3. Hjellming, R. M. (National Radio Astronomy Observatory, Charlottesville, VA). Science; 182: No. 4117, 1089-1095(14 Dec 1973).

The events of Sept. 1972 in which Cyg X-3 went through 2 major outbursts are described in detail. Radio, infrared, x-ray, and cosmic-ray observations are summarized. (WDM)

10996 RADIO HALOS AROUND OLD PULSARS: GHOST SUPERNOVA REMNANTS. Blandford, R. D. (Univ. of Cambridge, MA); Ostriker, J. P.; Pacini, F.; Rees, M. J. Astron. Astrophys.; 23: No. 1, 145-146(Feb 1973).

Old pulsars are expected to be surrounded by radio halos caused by relativistic electrons generated by the pulsar and diffusing away at the local Alfvén speed. The nonthermal source observed around CP 1919 may be of this type, since, in addition to the coincidence in position, there is rough quantitative agreement between observed and anticipated source properties. Other possible candidates are considered. (auth)

10997 INTERNAL MOVEMENTS ANALYSIS OF H II REGION NGC 7635. Maucherat, A.; Vuillemin, A. (Observatoire, Marseille). Astron. Astrophys.; 23: No. 1, 147-150(Feb 1973). (In French).

Radial velocities of the H II regions NGC 7635 and sharpless 162 measured from two interferograms are given. There is no significant discontinuity in radial velocities between NGC 7635 and S 162 which seem to belong to the same H II region. The form of NGC 7635 is explained. (auth)

10998 POLARIZATION IN INVERSE COMPTON SCATTERING OF SYNCHROTRON RADIATION. Bonometto, S.; Saggion, A. (Instituto di Fisica, Padua). Astron. Astrophys.; 23: No. 1, 9-13(Feb 1973).

The formulae are given for calculating the linear polarization of the emission due to inverse Compton scattering of synchrotron radiation. Both the cases of optically thin and optically thick (to their own synchrotron emission) sources are studied. Numerical results are also given showing that a substantial amount of the linear synchrotron polarization is preserved by the inverse Compton effect, though losses of an order up to 75 to 80% can often be present. Some applications of these results to astrophysical situations are proposed. The importance of carrying out the same kind of computation for circular polarization is also stressed. (auth)

10999 PLASMA EFFECTS AND THE ACCELERATION OF CHARGED PARTICLES IN PULSAR FIELDS. Kegel, W. H. (Univ., Heidelberg). Astron. Astrophys.; 22: No. 3, 475-477 (Feb 1973).

The acceleration of cosmic-ray particles in strong electromagnetic fields of the kind expected in the vicinity of pulsars is considered. It is shown that the results based upon the assumption of a vacuum wave have to be modified if $\omega_{pe}^2 > \Omega^2\alpha_e^3$ $(Zm_i/\pi m_e)^{\frac{1}{3}}$ where ω_{pe} is the electron plasma frequency, $\alpha_e = eE^0/cm_e\Omega$, E^0 and Ω the amplitude and frequency of the electric field, and m_i the mass and eZ the charge of the accelerated particle. In the case of the Crab pulsar, this condition is satisfied if $N_e > 2 \cdot 10^3$ cm^{-3} at the velocity of light radius. This implies in particular, that refractive index effects become important if the particle loss of the pulsar is larger than 10^{31} particles per second. This has to be compared with the generation of 10^{36} to 10^{40} energetic particles per second, required to explain the synchrotron radiation emitted by the Crab Nebula. That is, if these particles are injected by the pulsar, their acceleration must not be calculated using the approximation of a vacuum wave. (auth)

11000 PULSATION OF X-RAY SOURCES. Baan, W. A.; Treves, A. (Massachusetts Inst. of Tech., Cambridge). Astron. Astrophys.; 22: No. 3, 421-424(Feb 1973).

The emission from the x-ray sources Cen X-3 and Her X-1 is considered in the light of a model in which a neutron star is accreting matter transferred from a companion. It is shown that the accretion should occur through a magnetic funnel of which the angular width is estimated. Some difficulties of explaining the beaming of the x radiation are outlined, and possible solutions are suggested. (auth)

11001 OPTICAL IDENTIFICATIONS OF RADIOSOURCES FROM THE B 2 CATALOGUE QUASISTELLAR SOURCE. Bergamini, R.; Braccesi, A.; Colla, G.; Fanti, C.; Fanti, R.; Ficarra, A.; Formiggini, L.; Gandolfi, E.; Gioia, I.; Lari, C.; Marano, B.; Padrielli, L.; Tomasi, P.; Vigotti, M. (Univ., Bologna). Astron. Astrophys.; 23: No. 2, 195-207(Mar 1973).

A homogeneous sample of 70 blue stellar objects is presented, which exhibit the typical ultraviolet excess of quasars. These have been found during the program of optical identification of radiosources from the B 2 catalogue, using UBV plates of the 48″ Schmidt telescope of Mount Palomar. Some of these objects have been observed with the Westerbork instrument, to improve the radio positions and determine the distribution of the spectral indices between 408 and 1415 MHz. Comparing this distribution with the corresponding ones of a sample of galaxies and "empty fields," it is estimated that this last category of sources does not contain more than 20% of quasars. Finally the counts are examined as a function of the flux of the quasars, on the basis of the Schmidt model on the existence of a universal function giving the distribution of the ratios between the radio and the optical flux. (auth)

11002 FIRST 1415 MHz SURVEY WITH THE WESTERBORK SYNTHESIS RADIO TELESCOPE: AN ATTEMPT TO DETECT RADIO EMISSION FROM QUASISTELLAR OBJECTS. Katgert, P.; Katgert-Merkelijn, J. K.; Le Poole, R. S.; van der Laan, H. (Sterrewacht, Leiden). Astron. Astrophys.; 23: No. 2, 171-194 (Mar 1973).

A survey has been carried out with the Westerbork Synthesis Radio Telescope in an attempt to detect radio emission from a sample of suspected QSO's. Due to the high sensitivity of the instrument, sources with flux densities down to ≈0.007 f.u. can be detected in a single twelve-hour observation; positional accuracy is of the order of an arcsecond. Out of a total of 99 blue stellar objects, four are detected and another four may be radio emitting near the detection limit. Upper limits to the flux density are estimated for the remainder. A catalog of an additional 220 sources found in the survey is presented. An identification program has been carried out for these sources, yielding 14 possible quasars (including three of the suspected QSO's), 25 galaxies and nine possible galaxies. Some of the identifications should be called cluster identifications, when there are a number of galaxies close to the radio source. It is suggested that in these cases the cluster medium gives rise to the radio emission, rather than the individual galaxies. Source counts have been derived from a statistically unbiased sample: it is found that between 0.2 and 0.8 f.u. the number of sources found is a factor of two higher than was expected from an extrapolation of 1400 MHz source counts from other surveys covering a much larger area of the sky. Because possible systematic effects cannot account for the discrepancy, it is suggested that the excess must be explained by clustering on a scale of about 10 square degrees. Below 0.1 f.u. the differential counts fall definitely below an extrapolation of the earlier 1400 MHz counts, the most likely value for the slope being between −1.8 and −2.1. (auth)

11003 STATISTICAL INVESTIGATION OF THE PROPERTIES OF QUASARS. Fanti, R. (Univ., Bologna); Formiggini, L.; Lari, C.; Padrielli, L.; Katgert-Merkelijn, J. K.; Katgert, P. Astron. Astrophys.; 23: No. 2, 161-170(Mar 1973).

A discussion is given of most of the observational material concerning QSO's and QSS's. From the N(m)-relation and the V/V_{max}-test it is found that the density of both classes of objects increases with increasing distance; on the basis of redshifts (through the V/V_{max}-test) it is found that the co-moving density is proportional to $(1+z)^{6\pm1}$. An analysis of the bi-variate luminosity function of QSS's shows that this function can be conveniently described by postulating a correlation between the radio luminosity function and the optical luminosity such that the radio luminosity function depends on the ratio of radio and optical luminosity. Such a correlation makes it possible to have identical optical luminosity functions for QSO's and QSS's. This formulation gives a good account of the 3 CR, 4C, and B 2 data over a range of 1.6 decades in optical luminosity. The data show that QSO's with lower optical luminosities are very rarely radio-emitters. From the QSS-observations it is found that there exists a lower limit to

the ratio between radio and optical luminosity of $10^{2\cdot3}$. This means that radio observations of sufficiently high sensitivity should result in the detection of about one third of all QSO's in an optically complete sample. The actual number of detections falls short of this prediction by a factor of about three. A possible explanation for this effect is that at earlier epochs the radio emission of an average quasar was relatively less prominent (as compared to its optical emission) than it is now. (auth)

11004 GALACTIC LOOPS AS SUPERNOVA REMNANTS IN THE LOCAL GALACTIC MAGNETIC FIELD. Spoelstra, T. A. T. (Sterrewacht, Leiden). Astron. Astrophys.; 24: No. 1, 149-155 (Apr 1973).

Results from model calculations based on Van der Laan's model for a shell expanding in a magnetoionic medium are presented for Loop IV, the Lupus Loop, Monoceros Loop, and Origem Loop. It is indicated that the spatial orientation of the loops contains information on the direction of the magnetic field of the undisturbed medium outside the shell, B_0. The average direction of B_0 within a few hundred parsecs from the sun is to $l \approx 40°$. (auth)

11005 GALACTIC CONTINUUM LOOPS AND THE DIAMETER–SURFACE BRIGHTNESS RELATION FOR SUPERNOVA REMNANTS. Berkhuijsen, E. M. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astron. Astrophys.; 24: No. 1, 143-147(Apr 1973).

The linear diameter and average surface brightness at 1 GHz of 5 galactic continuum loops were estimated in order to find their positions in the D–Σ diagram for supernova remnants. The loops appear to fit the relation derived by Ilovaisky and Lequeux (1972a) reasonably well, which confirms the hypothesis that they are supernova remnants of great age (~10^6 years). A new D–Σ relation was computed for two cases. (auth)

11006 SEARCH FOR FAINT BLUE OBJECTS NEAR THE NORTH GALACTIC POLE. Weistrop, D. (Tel-Aviv Univ., Israel). Astron. Astrophys.; 23: No. 2, 215-219(Mar 1973).

Thirteen faint blue objects have been found near the North Galactic Pole. Three show significant variations in magnitude over a four-year period, and may be QSO's. Two have been identified as white dwarfs or subdwarfs by other authors, and one is most probably a white dwarf or subdwarf. (auth)

11007 DISTANCES OF THE QUASARS. Rowan-Robinson, M. (Queen Mary Coll., London). Astron. Astrophys.; 23: No. 3, 331-336(Mar 1973).

The implications of the proposal that there are two distinct classes of quasar (one "local", the other "cosmological") for observations of radio, optical, and x-ray frequencies are examined, and some possible models to explain the intrinsic redshift component in "local" quasars are considered. (auth)

Solar Phenomena

Refer also to abstract 11108.

11008 (N-73-20844) INITIAL STAGE OF DEVELOPMENT OF TYPE-4 RADIO BURSTS AND RELATION TO EXPANDING MAGNETIC BOTTLES. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Mar 1973. 21p. (NASA-TM-X-66217). NTIS $3.25.

Using observed data for wide-band Type IV solar radio bursts, the onset time differences between the microwave and metric frequencies and the peak flux intensities of the metric component were analyzed as a function of the longitudinal position of associated flares on the solar disk. It is shown that this time difference is dependent on the position of associated flares and that the peak flux intensity reaches maximum when a flare occurs in the region 10 to 40° west of the central meridian of the solar disk. These results are explained by taking into account the eastward expansion of magnetic bottles which trap mildly relativistic electrons responsible for Type IV bursts. Discussion is also made of the relation between these magnetic bottles and shock waves which excite Type II radio bursts. (auth) (STAR)

11009 (N-73-21704) PROPAGATION PATTERN OF INTERPLANETARY SHOCK WAVES ASSOCIATED WITH SOLAR PROTON FLARES. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1973. 24p. (NASA-TM-X-66226). NTIS $3.25.

The two-dimensional pattern of interplanetary shock waves is deduced by taking into account the solar longitude dependence of the time intervals between SSC geomagnetic storms and responsible flares. This pattern near the Earth's orbit is not symmetric with respect to the meridian plane which crosses the position of the flare, and the highest speed of this wave propagation is observed in the direction about 30° east of this meridian plane. The magnitude of the Forbush decreases of galactic cosmic rays also varies with the longitude positions of those flares. This is used to estimate the distribution of magnetic fields behind the shock waves. (auth) (STAR)

11010 (N-73-21705) INTERPLANETARY SHOCK WAVES ASSOCIATED WITH SOLAR FLARES IN THE ACTIVE REGION McMATH NO. 9740. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1973. 15p. (NASA-TM-X-66227). NTIS $3.00.

The propagation pattern of shock waves emitted by solar flares which occurred in the active region McMath No. 9740 during October 23 to November 4, 1968 is discussed. The solar flares were associated with Type 2 and 4 radio bursts and with SSC geomagnetic storms. The flares and associated phenomena are summarized and the transmit times between the Sun and the Earth of the shock waves associated with the flares are shown. It is concluded that the interplanetary magnetic field controls the propagation of shock waves emitted by solar flares. It was also determined that the large scale configuration of the interplanetary magnetic field was not disturbed by the successive propagation of the shock waves. (auth) (STAR)

11011 (N-73-21706) VARIATIONS OF RELATIVE ABUNDANCES OF He, (C,N,O), AND Fe-GROUP NUCLEI IN SOLAR COSMIC RAYS AND THEIR RELATIONSHIP TO SOLAR-PARTICLE ACCELERATION. Bertsch, D. L.; Biswas, S.; Fichtel, C. E.; Pellerin, C. J.; Reames, D. V. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1973. 23p. (NASA-TM-X-66228). NTIS $3.25.

Measurements of the flux of helium nuclei in the January 24, 1971 event and of helium and (C,N,O) nuclei in the September 1, 1971 event are combined with previous measurements to obtain the relative abundances of helium, (C,N,O), and Fe-group nuclei in these events. These data are then summarized together with previously reported results to show that, even when the same detector system using a dE/dx plus range technique is used, differences in the He/(C,N,O) value in the same energy/nucleon interval are observed in solar cosmic-ray events. Further, when the He/(C,N,O) value is lower the He/(Fe-group nuclei) value is also systematically lower in these large events. When solar particle acceleration theory is analyzed, it is seen that the results suggest that, for large events, Coulomb energy loss probably does not play a major role in determining solar particle composition at higher energies (>10 MeV). The variations in multicharged nuclei composition are more likely due to partial ionization during the acceleration phase. (auth) (STAR)

11012 (N-73-22745) TRANSVERSE LOW FREQUENCY WAVE IN A TWO FLUID SOLAR WIND. Solodyna, G. V. (Massachusetts Inst. of Tech., Cambridge (USA). Center for Space Research). 19 Jan 1973. 61p. (NASA-CR-131570; CSR-T-73-1). NTIS $5.25.

Thesis.

Investigation is made of the properties of low frequency transverse waves in a two-fluid solar wind having a radial magnetic field and radial streaming velocity. In order to examine what effects this streaming medium has on the waves, linearly polarized waves are decomposed into left and right circularly polarized waves. Computation is made of analytic expressions valid to first order for the radial amplitude and phase dependence of these constituent waves. It is shown that after traveling a given distance r, these waves have different amplitudes and phases. The former result causes their superposition to become elliptical rather than linear. The latter causes the axis of the ellipse of polarization to rotate through a well-defined angle. Analytic expressions are obtained for the eccentricity of the ellipse and for the angle of rotation. In analogy with regular Faraday rotation, in which the plane of polarization of a linear polarized wave rotates, the effect is denoted as generalized Faraday rotation. (auth) (STAR)

11013 (N-73-22758) SOLAR GAMMA RAYS AND NEUTRON OBSERVATIONS. Chupp, E. L.; Forrest, D. J.; Suri, A. N. (Max-Planck-Institut fuer Physik und Astrophysik, Garching/Munich (F.R. Germany). Inst. fuer Extraterrestrische Physik). Dec 1972. Contract NAS5-11054. 33p. (NASA-CR-131866). NTIS $3.75.

From symposium on high energy phenomena on the Sun; Greenbelt, Maryland, USA (28 Sep 1972).

The present status of knowledge concerning the impulsive and the continuous emission of solar gamma rays and neutrons is reviewed in the light of the recent solar activity in early August 1972. The gamma-ray spectrometer on OSO-7 has observed the Sun continuously for most of the activity period except for occultation by the Earth. In association with the 2B flare on August 4, 1972 and the 3B flare on August 7, 1972, the monitor provides evidence for solar gamma-ray line emission in the energy range from 300 keV to 10 MeV. A summary of all the results available from preliminary analysis of the data is given. Significant improvements in future experiments can be made with more sensitive instruments and more extensive time coverage of the Sun. (auth) (STAR)

11014 (N-73-22795) SOLAR MAGNETIC FIELDS: EXTENDED. Wilcox, J. M. (California Univ., Berkeley (USA). Space Sciences Lab.). 29 Jun 1971. Contract N00014-69-A-0200-1049. 33p. (NASA-CR-131832). NTIS $3.75.

From symposium on magnetic field in stars; Wailu, Hawaii, USA (Jun 1971).

Spacecraft observations of the interplanetary magnetic field have revealed that almost always each solar rotation can be divided into sectors, within each of which the field has a predominant polarity toward the Sun or away from the Sun. Comparisons of this interplanetary magnetic sector pattern with observations of the photospheric magnetic field have revealed a similar solar magnetic pattern. The boundaries between solar magnetic sectors are approximately in the north–south direction over a wide range of latitudes on both sides of the equator. This solar magnetic sector structure can be described as a rotating dipole whose magnetic axis makes an angle of approximately 90 deg with the axis of rotation. Possible similarities between this solar magnetism and the models derived from observations of stellar magnetism are discussed. (auth) (STAR)

11015 (N-73-24814) OUTER LIMIT FOR EXPANSION OF MAGNETIC BOTTLES EJECTED BY SOLAR PROTON FLARES. Sakurai, K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). May 1973. 14p. (NASA-TM-X-66243). NTIS $3.00.

Pioneer 6 observations of proton flare ejected magnetic bottles are reported. The SSC geomagnetic storms, electron density distribution near the Sun, and Faraday rotation induced by the flares are included. Magnetic bottle speed is discussed. (STAR)

11016 (N-73-25846) QUIET SUN. Gibson, E. G. (National Aeronautics and Space Administration, Washington, D.C. (USA)). 1973. 344p. (NASA-SP-303). GPO $5.75.

An up-to-date textbook of solar physics is presented. The solar structure and processes, and the interior are described along with the photosphere, the chromosphere, and the corona. The strongest Fraunhofer lines, visible coronal lines, and coronal uv, xuv, and x-ray lines are listed. (STAR)

11017 (N-73-25847) DAMPING OF HIGH-FREQUENCY WAVES IN THE SOLAR WIND. Goldstein, M. L.; Fisk, L. A. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1973. 17p. (NASA-TM-X-66254). NTIS $3.00.

Cyclotron damping by suprathermal fluxes of protons and electrons in the interplanetary medium will greatly attenuate high frequency Alfven waves and whistler waves within distance < 1 AU of the Sun. Electrons with energies between 50 eV to 2 keV are heated as a result of damping interplanetary whistler waves with frequencies $2 < \Omega/2\pi <$ Hz in the frame of the solar wind. This heating may account, in part, for the observed suprathermal tail of solar wind electrons. Protons with energies approximately < 50 keV damp Alfven waves with frequencies $.001 < \Omega/2\pi < .01$ Hz. This damping mechanism may explain several features of scatter free solar electron events and high intensity, anisotropic solar proton streams. (auth)

11018 (N-73-25849) HIGH RESOLUTION STUDIES OF THE SOLAR X-RAY CORONA FROM AEROBEE ROCKETS. Final Report, 15 December 1971–30 April 1973. Davis, J. M.; Haggerty, R.; Krieger, A. S.; Manko, H.; Sherman, G.; Ting, J. W. S.; Vaina, G. S. (American Science and Engineering, Inc., Cambridge, Mass.). 30 Apr 1973. Contract NASw-2347. 48p. (NASA-CR-132984; ASE-3268). NTIS $4.50.

The research in high-resolution solar x-ray astronomy is reported. The payload for the Aerobee 150 launch vehicle, which included a 23 cm diameter mirror whose polished surface was a nickel–phosphorus alloy is discussed along with the high-resolution measurements, by Flight 13.028 CS, of the temperature and density structure of the lower corona. Flight 13.029 CS is also discussed. (STAR)

11019 (N-73-25881) FLARES OF AUGUST 1972. Zirin, H.; Tanaka, K. (California Inst. of Tech., Pasadena (USA)). 1972. 44p. (NASA-CR-132195; BBSO-128). NTIS $4.25.

Analysis is made of observations of the August, 1972 flares at Big Bear and Tel Aviv, involving monochromatic movies, magnetograms, and spectra. In each flare the observations fit a model of particle acceleration in the chromosphere with emission produced by impact and by heating by the energetic electrons and protons. The region showed twisted flux and high gradients from birth, and flares appear due to strong magnetic shears and gradients across the neutral line produced by sunspot motions. Post flare loops show a strong change from sheared, force-free fields parallel to potential-field-like loops, perpendicular to the neutral line above the surface. (auth)

11020 (N-73-27719) PIONEER SOLAR PLASMA AND MAGNETIC FIELD MEASUREMENTS IN INTERPLANETARY SPACE DURING 2–17 AUGUST 1972. Mihalov, J. D.; Colburn, D. S.; Smith, B. F.; Sonett, C. P.; Wolfe, J. H. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). May 1973. 17p. NTIS $3.00.

Solar-wind plasma and magnetic-field measurements from Pioneers 9 and 10 during August 2–17, 1972, reveal complex and large-amplitude variations on a one-hour time scale and numerous discontinuities. During this time period an approximate radial alignment of the two spacecraft as seen from the Sun occurred with heliocentric distances of 0.8 AU for Pioneer 9 and 2.2 AU for Pioneer 10, both at 45° east of the Earth's solar longitude. The peak hourly average solar-wind proton bulk velocity measured at Pioneer 9 was 990 km/sec during hour 0 UT of August 5. The peak hourly average proton number density was 62/cu cm during hour 11 UT of August 3. The peak solar-wind speeds are generally much reduced at Pioneer 10 compared with those observed at Pioneer 9. The peak 30 minute average magnetic-field magnitude was 85 gamma during 1245-1315 UT of August 3. The Pioneer 9 data indicate passage of four fast forward interplanetary shocks, and one slow forward interplanetary shock. (auth)

11021 (N-73-27720) SPATIAL DISTRIBUTION OF SOFT X-RAY AND EUV EMISSION ASSOCIATED WITH A CHROMOSPHERIC FLARE OF IMPORTANCE 1B ON 2 AUGUST 1972. Neupert, W. M.; Thomas, R. J.; Chapman, R. D. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jul 1973. 56p. (NASA-TM-X-66299). NTIS $5.00.

Soft x-ray and extreme ultraviolet spectroheliographs carried by the OSO-7 were used to record the development of xuv emission associated with a flare of importance 1B on August 2, 1972. Spatial resolution was 20 arc sec and spectral resolution was adequate to select emission lines originating within well-defined ranges of electron temperature between 50,000 and 30,000,000 K. The data show that heating only the pre-existing coronal material adjacent to the flare site cannot account for the soft x-ray emission measure observed during the event. The flare emission originating at $T_e \leq 2{,}300{,}000$ K exhibits an impulsive component coincident with an impulsive microwave event. This radiation appears to coincide spatially with H alpha radiation emitted at that time and is centered on the neutral line separating magnetic fields of opposite polarity. The region with highest electron temperature exhibits the greatest stability in position. This region cools to approximately 10^7 K in 6 to 12 minutes which is compatible with cooling by conduction to the chromosphere. The best association with a dark surge is found in an emission line of Fe XIV. (auth)

11022 (N-73-27721) ANALYSIS OF SOLAR X-RAY DATA. Acton, L. W.; Zaumen, W. T. (Lockheed Missiles and Space Co., Sunnyvale, Calif. (USA)). May 1973. Contract NASw-2316. 51p. (NASA-CR-133341). NTIS $4.75.

Measurements of the intensity of a group of iron lines around 1.9A and the x-ray continuum in the 1 to 3A region have been obtained from rocket experiments during the declining phases of two small solar flares. The electron temperature, effective ionization temperature of iron, electron density and source volume as a function of time are interpreted in terms of the plasma cooling mechanisms. Also included is a review of observational material from a variety of space measurements on solar activities. (STAR)

11023 (N-73-28826) LARGE-SCALE STRUCTURE OF THE SOLAR WIND. Wolfe, J. H. (National Aeronautics and Space Administration, Huntsville, Ala. (USA). George C. Marshall Space Flight Center). Mar 1971. 100p. (NASA-TM-X-69342). NTIS $7.00.

From solar wind conference; Pacific Grove, California, USA (22 Mar 1971).

The solar-wind structure is reviewed based on experimental space measurements acquired over approximately the last decade. The character of the interplanetary medium is considered from the viewpoint of the temporal behavior of the solar wind over increasingly longer time intervals, the average properties of the various solar-wind parameters and their interrelationships. A brief discussion is included of interplanetary–terrestrial relationships and the expected effects of heliographic latitude and radial distance. (auth)

11024 (N-73-29865) INTERPLANETARY CHARGED-PARTICLE ENVIRONMENTS. Divine, T. N. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Aug 1973. Contract NAS7-100. 58p. (NASA-CR-133600; JPL-TM-33-637). NTIS $5.00.

Current state-of-the-art knowledge of the solar wind, solar particle events, and galactic cosmic rays is reviewed for the development of space vehicle design criteria based on these interplanetary environments. These criteria are described quantitatively in terms of intensity, flux, and fluence, and their dependences on time, posi-

tion, and energy, and the associated probabilities and related parameters, for electrons, protons, and other ions. (auth)

11025 (TRITA-EPP-72-3) LOCAL-HYDROGEN AND THE BACKGROUND LYMAN ALPHA PATTERN AND INTERACTION BETWEEN THE INTERSTELLAR MEDIUM AND SOLAR WIND PLASMA. Wallis, M. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Jun 1972. 52p. Dep. NTIS (U.S. Sales Only) $4.75.

The background Lyman-α observations are interpreted on the interstellar wind picture, taking into account the radiation transfer problems. The intensity minimum is provided mainly by near-isotropic cavity radiation, while the anisotropic contribution derives from the asymmetric distribution of nearby gas inside the cavity. OGO 5's values for the maximum and minimum intensities lead to interstellar densities in excess of 0.1 H-atoms/cm^3 and quite possibly as high as the 0.2 to 0.3/cm^3 of independent local derivations. Whether the gas is hot or cold is not easy to determine. Collisional heating explains the absence of a subsidiary maximum deriving from gravitational focusing of cool gas. Extension of transfer theory to cover a diffuse inner boundary to the cavity could help exclude high temperatures (10^4°K). Observations at various phases of the solar cycle and more precise determinations of the annual parallactic motion of the maximum could also fix the temperature. (auth)

11026 SOLAR ACTIVITY AND ITS FORECAST. Pick, M.; Simon, P. (Observatoire de Paris, Meudon, France). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1303-1306(Sep 1973).

An essential problem for solar activity forecasting is understanding the physical basis of solar activity phenomena. During the last decade, interest shifted from a global evaluation of the active centers to a detailed study of their microscopic magnetic components. This allows for the possibility of an identification of the flare sites but we do not understand the physical process of the triggering itself. The x-ray data give some evidence that during a flare the particles were accelerated in two distinct phases. Obviously other processes of particle acceleration are at work on the sun: transient perturbations of the chromosphere linked to Type-III bursts are thought to be connected to an acceleration of subrelativistic electrons which may or may not trigger an optical flare. High time resolution data show that many events are so complex that in the future they will have to be taken into account. Since forecasting centers need a worldwide network, they cooperate through the International Ursigram and World Day Service (IUWDS): They agree on a permanent program of data exchanges and daily forecasts and on temporary projects. Several such projects are briefly reported in order to illustrate the variety of the requests that a warning center has to fulfill. (auth)

11027 SOLAR RADIO PATROL NETWORK OF THE USAF AND ITS APPLICATION. Castelli, J. P.; Arrons, J.; Guidice, D. A.; Straka, R. M. (Air Force Cambridge Research Labs., Bedford, MA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1307-1312(Sep 1973).

Through the conceptual and equipment development work and the continuing technical guidance of Air Force Cambridge Research Laboratories (AFCRL), the first uniform global network of solar radio monitoring has been established to make accurate routine observations of the Sun at frequencies from 245 to 35,000 MHz. From research carried out at AFCRL, several important techniques have been developed having operational, scientific, and forecasting applications. First, the U-shape spectral criteria were developed for a yes–no prediction of principal polar cap absorption (PCA) events. Later, the use of integrated flux density of large bursts was used to forecast the proton flux and magnitude (decibel absorption) of the PCA resulting from the solar disruption. Comprehensive statistical studies of the spectral properties of radio bursts have led to a better understanding of burst-region parameters. More recently, studies of the burst spectral development for spectacular events have been used to investigate the mechanism involved in particle and nonradio emission to ultimately predict the probable spectra of energetic particles and to suggest the times of maximum accelerations during the parent flare. (auth)

11028 THREE-FREQUENCY OPERATION OF THE CULGOORA RADIOHELIOGRAPHY. Sheridan, K. V.; Labrum, N. R.; Payten, W. J. (CSIRO, Epping, Australia). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1312-1317(Sep 1973).

The advantages to be obtained from multifrequency operation of the Culgoora radioheliograph were appreciated during the early design phase of the original 80-MHz system and steps were taken then to facilitate the addition of other observing frequencies. The heliograph has already been converted to operate at both 80 and 160 MHz and work is well advanced to add a third frequency of 43.25 MHz. After describing the original 80-MHz system this paper outlines reasons for the choice of these frequencies and shows how the system was modified to incorporate them. (auth)

11029 PROPOSED MILLIMETER RADIOHELIOGRAPH. McLean, D. J. (CSIRO, Epping, Australia). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1318-1320(Sep 1973).

A radio telescope capable of two-dimensional mapping of the Sun at a millimeter wavelength with resolution of a few seconds of arc would add greatly to the knowledge of the Sun and solar flares. A design which promises to make such an instrument possible is being studied at present. The novel features of this design are fast rotational synthesis and a technique for using redundancy in the array to calibrate the phases continuously. (auth)

11030 ELECTROOPTICAL RADIO SPECTROGRAPH. Cole, T. W. (CSIRO, Epping, Australia). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1321-1323(Sep 1973).

The electrooptical radio spectrograph is presented as a sensitive way to record the spectrum of a relatively wide frequency range with high resolution in both time and frequency. It takes advantage of the high recording density of photographic film and the high data rates of coherent optical processing systems. An instrument is described which records the spectrum over a 100-MHz frequency range. It has a frequency resolution of 130 kHz with low "sidelobe" response, good sensitivity, and a time resolution of up to 50 ms. Some of the applications of the instrument to radio astronomy are described. (auth)

11031 8-mm INTERFEROMETER FOR SOLAR RADIO ASTRONOMY AT BORDEAUX, FRANCE. Delannoy, J. (Observatoire de Bordeaux); Lacroix, J.; Blum, E. J. Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1282-1284(Sep 1973).

A small two-antenna interferometer working at a wavelength of 8 mm, with a baseline of 64 m is now completed at the Observatory in Bordeaux. The new instrument is designed for solar studies and for experimentation in millimeter-wave interferometry. The main characteristics are given with some details on techniques used, in particular for local-oscillator (LO) transmission and phase stability, and for antenna drive and encoding systems. (auth)

11032 DETERMINATION OF THE TEMPERATURE OF THE SUN, USING THE CN MOLECULAR BAND SYSTEM. Porfir'eva, G. A. (State Astronomical Inst., Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 148-149(1973).

Translated from Astron. Zh.; 50: No. 1, 221-222(1973).

The rotational and vibrational temperatures of the CN molecule at the center of the solar disk and at sin v = 0.95 are calculated and compared, providing a preliminary interpretation of the previous finding (1972) that the turbulence velocity derived from the half-widths of CN line profiles is independent of sin v. The two temperatures are equal, within the observational error. Certain revisions are made in a method used earlier to determine T_{rot}, and the values of T_{rot} and T_{vib} at the center of the disk are redetermined. (auth)

11033 NON-LTE LINE FORMATION IN A MAGNETIC FIELD. I. Noncoherent Scattering and True Absorption. Domke, H. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.); Staude, J. Solar Phys.; 31: No. 2, 279-289(Aug 1973).

The formation of a Zeeman-multiplet by noncoherent scattering and true absorption in a Milne–Eddington atmosphere is considered assuming a homogeneous magnetic field and complete depolarization of the atomic line levels. The transfer equation for the Stokes parameters is transformed into a scalar integral equation of the Wiener–Hopf type which is solved by Sobolev's method in closed form. The influence of the magnetic field on the mean scattering number in an infinite medium is discussed. The solution of the line formation problem is obtained for a Planckian source function. This solution may be simplified by making the "finite field approximation", which should be sufficiently accurate for practical purposes. (auth)

11034 NON-LTE LINE FORMATION IN A MAGNETIC FIELD. II. The Influence of Noncoherent Scattering on Line Contours. Domke, H. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.); Staude, J. Solar Phys.; 31: No. 2, 291-298(Aug 1973).

Theoretical line contours calculated for fixed values of the line constants and a given model atmosphere show an increase of the Stokes parameters Q, U, and V but a decrease of I if the portion of noncoherent scattering increases. These effects increase from the center of the solar disk to the limb. The action of scattering may be approximately simulated in LTE contours by increasing the gradient of the source function and fitting in this way theoretical contours to observed ones. There remains, however, the effect of V-reversal near the line core, which is caused by anomalous dispersion and is abnormally increased by scattering. (auth)

11035 PERTURBATIVE SOLUTION OF THE TRANSFER EQUATIONS FOR THE STOKES PARAMETERS IN A MAGNETIC

FIELD. Landi Degl'Innocenti, E.; Landi Degl'Innocenti, M. (Astrophysical Observatory of Arcetri, Florence). Solar Phys.; 31: No. 2, 299-305(Aug 1973).

The transfer equations for the Stokes parameters, as derived under the assumption of LTE and in the general case of anomalous Zeeman multiplet, are solved by a perturbative method that reduces the system of four coupled linear differential equations to an iterative series of well known linear differential equations. The perturbation parameter turns out to be of the order of magnitude of the ratio of the Larmor frequency to the line Doppler half-width, so that the method appears to be particularly suitable for small magnetic fields. Some qualitative results on the importance of Faraday rotation and the orders of magnitude of the line profiles of the Stokes parameters are obtained. (auth)

11036 COMPARISON OF THE MAGNETOGRAPHIC MAGNETIC FIELD MEASURED IN DIFFERENT SPECTRAL LINES. Gopasyuk, S. I.; Kotov, V. A.; Severny, A. B.; Tsap, T. T. (Crimean Astrophysical Observatory, USSR). Solar Phys.; 31: No. 2, 307-316(Aug 1973).

The discrepancies in the values of longitudinal magnetic field obtained from magnetographic records in different spectral lines are considered. On the basis of extensive data including 60 pairs of magnetographic maps for 11 spectral lines, obtained simultaneously for one of these lines and λ6103 with the aid of the Crimean double channel magnetograph, the following conclusions have been reached. The relative field strength $\delta(\lambda_i) = H_{||}(\lambda_i)/H_{||}$ (6103) depends partly on the distance from the center of the disk (Figure 4) and mainly on the magnetic sensitivity of the line $g\lambda^2$, pointing to the primary role of saturation effect. The possible influence of line asymmetry on these discrepancies is also suggested. (auth)

11037 TELLURIC LINES IN THE VICINITY OF λ5250 AND λ6562 Å. Livingston, W.; Ramsey, L. (Kitt Peak National Observatory, Tucson, AZ). Solar Phys.; 31: No. 2, 317-318(Aug 1973).

Measurements of the Sun's circulation, as derived from the Doppler displacements of Fraunhofer lines, are subject to error if the solar components are contaminated by weak, perhaps undetected, atmospheric blends (Livingston and Milkey, 1972). This note presents the telluric content of two spectral regions of interest: the vicinity of Fe I 5233.0 – Fe I 5250.2, and Hα 6562. The threshhold of detection is considerably better than previously achieved (see, for example, Moore et al., 1966). (WDM)

11038 STUDIES OF THE SOLAR CHROMOSPHERE FROM MILLIMETRE AND SUB-MILLIMETRE OBSERVATIONS, II. Simple Models of the Lower Chromosphere. Beckman, J. E.; Clark, C. D.; Ross, J. (Queen Mary Coll., London). Solar Phys.; 31: No. 2, 319-338(Aug 1973).

A compilation of brightness temperature data in the millimeter and sub-millimeter wavelength ranges is used to obtain an empirical relation $T_B = C\lambda^3$ between brightness temperature and wavelength, valid between 1 mm and 1 cm. An analytically soluble model, giving electron temperatures and densities between 1500 km and 4000 km above the photosphere, is derived from this relationship, and eclipse data of Thomas and Athay, of the emission at the head of the Balmer continuum. Although this over-simplified model lacks precision in the height coordinate, it allows a scale height of around 1000 km for electrons to be deduced, and supplies a convincing test for the absence of hydrostatic equilibrium throughout the region. A more comprehensive and reliable though still simplified numerical model is then presented, being a modification of previous models accounting only for millimeter data. It shows marked departure from uv derived models in this region, and an explanation for the discrepancy is proposed in terms of thermal inhomogeneities on the scale of the chromospheric supergranulation. The stratified model is then geometrically modified to account for observed centerlimb profiles of the Sun measured throughout the sub-millimeter and millimeter region. The scale of any roughness thus introduced is related to the notable lack of millimetric limb brightening, and observational tests for that scale are suggested here. A qualitative picture of this part of the chromosphere is proposed, consistent with existing observations in the millimeter, visible and uv regions of the spectrum. (auth)

11039 $3p^6 3d^n - 3p^5\ 3d^{n+1}$ SPECTRA OF Fe VI AND Fe VII. Fawcett, B. C. (Culham Lab., Abingdon, Eng.); Cowan, R. D. Solar Phys.; 31: No. 2, 339-341(Aug 1973).

Atomic self consistent field calculations were applied to identify Fe VI and Fe VII spectra belonging to the $3p^6 3d^n - 3p^5 3d^{n+1}$ transition arrays. Their presence in vacuum spark spectra and absence in solar spectrograms are discussed. (auth)

11040 QUIET CORONA DENSITY MODEL FOR THE LAST MAXIMUM OF SOLAR ACTIVITY. Leblanc, Y. (Observatoire de Meudon, France); Leroy, J. L.; Pecantet, P. Solar Phys.; 31: No. 2, 343-350(Aug 1973).

Observations of quiet K corona in maximum activity phase (1970 and 1972) were selected and the corresponding density models were computed. The density was found to be two times smaller than in average maximum coronal models (Newkirk, 1967) and nearly equal to that of minimum coronas (Saito, 1970). The research of quiet coronas between active periods was extended to the three past solar cycles thanks to λ5303 Å measurements: very low λ5303 Å intensities, corresponding to very small densities, were found even in maximum activity phase. A short discussion about the values of average quiet coronal models is given. (auth)

11041 DYNAMICAL MODEL OF THE CORONA. Browne, S. L.; Bessey, R. J. (Univ. of Wyoming, Laramie). Solar Phys.; 31: No. 2, 351-375(Aug 1973).

The hydrodynamic equations for an ideal, inviscid, fully ionized hydrogen gas in a gravitational, but not magnetic, field were solved by an explicit Lax–Wendroff two-step technique using a one-dimensional slab symmetry. Radiation and thermal conductivity were included. The model spans 100,000 km starting from the chromosphere–corona transition region. An initially isothermal gas is seen to evolve coronal properties in 4000 s, by which time it settles into dynamic equilibrium characterized by a 2000 km transition region, a temperature maximum of 1.6×10^6 K at a height of 60,000 km, and a solar wind mass flux of 10^{-9} g cm^{-2}s^{-1}. (auth)

11042 MORPHOLOGICAL STUDY OF THE LIGHT-BRIDGES IN SUNSPOTS. Vazquez, M. (Univ., La Laguna, Spain). Solar Phys.; 31: No. 2, 377-387(Aug 1973).

This study was based on photographs taken during the period March 1971 to June 1972. Various morphological features observed are described and their possible role in sunspot evolution discussed. It is pointed out that a light-bridge looks like the re-establishment of photospheric-like conditions. (auth)

11043 Hα FLARE AS A SECONDARY PRODUCT OF A CORONAL INSTABILITY. Svestka, Z. (Fraunhofer Inst., Freiburg i. B.). Solar Phys.; 31: No. 2, 389-400(Aug 1973).

The assumption that the flare originates in the corona or transition layer is confronted with the known properties of chromospheric flares. It is concluded that the basic mode of the energy transport into chromosphere is heat conduction. Only in some flares nonthermal particles contribute to the brightening in lower atmospheric layers: electrons with energy close to 100 keV produce chromospheric bright patches, and protons above 20 MeV cause the photospheric enhancements. The particle-produced brightenings are superimposed on the basic quasi-thermal flare and involve only small areas as compared with the extensive regions heated through conduction. The most probable height of the flare origin appears to be close to the transition layer, between some 4000 and 7000 km above the photosphere. The nonthermal acceleration (when present) occurs probably higher than where the flare originates. There is no obvious reason why the high electron density in chromospheric flares could not be explained as simply due to increased ionization in the existing plasma, without any flare-induced mass condensations. Though there are several facts supporting the flare origin in the corona (or transition layer), one cannot exclude the alternative that the flare instability involves simultaneously a wide (and in different cases different) range of altitudes. Energy considerations give some support to such a supposition. (auth)

11044 RESULTS OF CALCULATIONS OF THE CHROMOSPHERIC FLARE INITIAL PHASE MODEL ACCORDING TO THE STRONG GASODYNAMIC EXPLOSION THEORY. Guseinov, R. E. (Shemakha Astrophysical Observatory, Azerbaijan, USSR). Solar Phys.; 31: No. 2, 401-410(Aug 1973).

It is shown that while comparing the observed dependences of radius, front, and plasma velocities at the time of the very initial flare phase with the family of the theoretical curves of these functions obtained according to strong explosion theory with the set of the initial density ρ_0 and estimated from the observations of the total flare energy E_0, one can determine ρ_0 in the flare core. Knowing ρ_0 and E_0, densities in the filaments responsible for the flare radiation and the effective and spectroscopic radiation volumes as well, one can determine the effective mass and the density between the filaments. The estimated mass, electron temperature, front, and plasma velocities and densities both in the filaments and in the intervals are in satisfactory agreement with the modern concept of flares. (auth)

11045 EXTREME ULTRAVIOLET SPECTRUM OF THE SOLAR FLARE OF 2114 UT MARCH 27, 1967. Donnelly, R. F. (National Oceanic and Atmospheric Administration, Boulder, CO); Hall, L. A. Solar Phys.; 31: No. 2, 411-426(Aug 1973).

Scanning spectrometer measurements in the range 1310 to 270 Å, observed from the satellite OSO 3, are reported for the solar flare of 2114 UT March 27, 1967. This flare was a long

lasting sequence of bursts with euv spectra consisting of enhanced lines and recombination continua normally emitted from the chromosphere and chromosphere–corona transition region, with unusually small increases in lines normally emitted from the corona. An euv flare spectrum is presented and suggested as one example for interpreting broadband observations of euv bursts. Any broad-band continuum other than known recombination continua contributed less than 6% of the measured line and hydrogen recombination continua in the range 270 to 1310 Å. The ratio of photon flux of CIII 1176 Å to that of CIII 977 Å was 0.86, which suggests an ambient density in the region of emission greater than 10^{12} cm^{-3} at temperatures near 60,000 K. (auth)

11046 MACROSCOPIC MOTIONS IN PROMINENCES. II. Optical Pairs and Interacting Prominences. Gallegos, H. G.; Machado, M. E. (Observatorio Nacional de Fisica Cosmica, San Miguel, Argentina). Solar Phys.; 31: No. 2, 427-436(Aug 1973).

Three pairs of prominences were studied, two of them clearly showing the effect of interaction by a dynamical plasma bridge. The other one was a superimposed optical pair which also showed, after being spectroscopically studied, the possible effect of interaction. The atom density in the prominence and bridges was calculated, and the Goldberg–Unno method for the determination of Doppler-widths of the calcium H and K lines was applied. (auth)

11047 MECHANISM OF FORMATION OF LOOP PROMINENCES. De, B. R. (Univ. of California, San Diego, La Jolla). Solar Phys.; 31: No. 2, 437-447(Aug 1973).

A mechanism is suggested for the formation of loop-type prominences in solar-active regions following flare events. The mechanism is based on the already existing idea of compression of a coronal plasma element resulting in enhanced radiation and consequent cooling of the element. A model is suggested for such a compression based on the concept of a contracting, force-free filamentary structure. If the current in a filament increases with time, then there is a radial contraction of the filament. Since the coronal plasma is frozen into the magnetic field lines of the filament, a contraction of the filament causes a compression of the filamentary plasma. This model of compression is shown to be in approximate qualitative and quantitative agreement with observations. (auth)

11048 CORONAL DISTURBANCES. I. Fast Transient Events Observed in the Green Coronal Emission Line During the Last Solar Cycle. Demastus, H. L. (AFCRL, Sunspot, NM); Wagner, W. J.; Robinson, R. D. Solar Phys.; 31: No. 2, 449-459(Aug 1973).

Time lapse movies acquired with the Sacramento Peak Observatory 6-in filter coronagraph very infrequently show dramatic transient events. Many of these events (at $1.04 < r/r_{\odot} < 1.20$) are correlated with Hα activity at the limb, especially with large surges and eruptive prominences. Metric or centrimetric radio bursts are found associated with certain types of λ5303 coronal events. The heights to which such disturbances will propagate can often be estimated from the green line movie data. The results of a study of all the examples of such transients observed during the last 16 years are reported. (auth)

11049 POLARIZATION OF SOLAR ACTIVE REGIONS AT 3.5 MILLIMETER WAVELENGTH. Kundu, M. R.; Gergely, T. (Univ. of Maryland, College Park). Solar Phys.; 31: No. 2, 461-467 (Aug 1973).

A study of the circular polarization structure of solar active regions was made from data obtained at 3.5 mm wavelength, using the 36 ft diameter radio telescope of the National Radio Astronomy Observatory at Kitt Peak, Arizona. The angular resolution of the telescope at this wavelength is 1.2'. All important active regions observed at 3.5 mm were bipolar in nature; the degree of polarization ranged from 1 to about 2%. These oppositely polarized components corresponded with the Mt. Wilson magnetic regions of opposite polarity; the line of zero polarization delineated the neutral line between the regions of opposite polarity on magnetograms. The longitudinal magnetic fields at the level of 3.5 mm emission computed from the degree of polarization were found to be several hundred gauss. (auth)

11050 INTERFEROMETER OBSERVATIONS OF A RADIO BURST AT 8.6 mm ASSOCIATED WITH A POLARIZED HARD X-RAY EVENT. Kawabata, K.; Sofue, Y.; Ogawa, H.; Omodaka, T. (Nagoya Univ., Japan). Solar Phys.; 31: No. 2, 469-481(Aug 1973).

Observations of a radio burst at 8.6 mm wavelength on November 5, 1970 are described with the particular interest on the correspondence between radio and polarized x-ray events. The radio observations were carried out using an interferometer with a half power width of 2.9' at Nagoya University, and indicated that the location of the radio burst coincided with preceding sunspots and the size of the burst source must be very small, less than about 1'. Mechanisms of radio and x-ray emissions are discussed briefly. (auth)

11051 INITIAL STAGE OF DEVELOPMENT OF TYPE IV RADIO BURSTS AND THE RELATION TO EXPANDING MAGNETIC BOTTLES. Sakurai, K. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 31: No. 2, 483-492(Aug 1973).

Using the observed data for wide-band Type IV solar radio bursts, the onset time differences between the microwave and metric frequencies and the peak flux intensities of the metric component are analyzed as a function of the longitudinal position of the associated flares on the solar disk. It is shown that this time difference is dependent on the position of the associated flare and that the peak flux intensity reaches maximum when a flare occurs in the region 10 to 40° west of the central meridian of the solar disk. These results are explained by taking into account the eastward expansion of magnetic bottles which trap mildly relativistic electrons responsible for Type IV bursts. Discussion is given on the relation between these magnetic bottles and shock waves which excite Type II radio bursts. (auth)

11052 HELIOGRAPHIC LONGITUDE DISTRIBUTION OF THE FLARES ASSOCIATED WITH TYPE III BURSTS OBSERVED AT KILOMETRIC WAVELENGTHS. Alvarez, H.; Haddock, F. T.; Potter, W. H. (Univ. of Michigan, Ann Arbor). Solar Phys.; 31: No. 2, 493-500(Aug 1973).

Observed Type III solar bursts were grouped according to the discrete frequencies of observation in the kilometric wavelength range. For each group the bursts' frequency of occurrence as a function of the heliographic longitude of the associated optical flares was obtained. It was found that flares occurring east of a certain cutoff longitude do not produce bursts observable near the Earth below a given frequency. The cutoff on the west is determined by observational limitation for flares beyond the limb. The mean longitude and the extreme eastern end of the longitude distribution both shift to the west as the radio frequency decreases. These findings were interpreted in terms of radio-wave propagation effects and curved trajectories of the bursts' exciter particles. (auth)

11053 CHARACTERISTICS OF TYPE III EXCITERS DERIVED FROM LOW FREQUENCY RADIO OBSERVATIONS. Evans, L. G.; Fainberg, J.; Stone, R. G. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 31: No. 2, 501-511(Aug 1973).

Low-frequency radio observations (2.8 MHz to 67 kHz) from the RAE-1 and IMP-6 satellites allow the tracking of Type III solar burst exciters out to large distances from the Sun (of the order of 1 AU). A study of the interaction processes between the exciter and the interplanetary medium was made using the time-intensity profiles of the radio emission. The change in exciter length with distance from the Sun and the resulting exciter velocity dispersion which can be deduced from this change were investigated. From detailed measurements on 35 simple bursts it was found that the exciter length increases at a faster rate than a constant velocity dispersion would give. The damping of the radio emission was also investigated and it was concluded that some current theories of the damping mechanism give results which are not consistent with the low frequency observations. (auth)

11054 U-LIKE RADIO BURST OBSERVED WITH HIGH SPACE–TIME RESOLUTION. Caroubalos, C.; Couturier, P.; Prokakis, T. (Observatoire, Meudon, France). Astron. Astrophys.; 23: No. 1, 131-138(Feb 1973).

On July 19, 1971, a U-like burst was recorded on 169 MHz by the Nancay radioheliograph. High space–time resolution records and spectral data are available on that event of which only the upper part was observed. The spectrum showed both the fundamental and harmonic component plus an isolated bright spot at 275 MHz which occurred right at the turning point of the burst. The descending branch of the burst was wider in extent and less intense than the ascending branch. Using Fokker's (1970) method and the available coronal magnetic field map, the velocity and trajectory of the exciter were derived. The widening and the reduction in brightness of the descending branch as well as details of the dynamic spectra are interpreted consistently assuming the presence of a helmet streamer associated with a neutral sheet (Pneuman, 1972) located at the upper part of the magnetic arch which guides the exciter. This model can be used to interpret most kinds of U-bursts. (auth)

11055 ANOMALOUS ELECTRON IMPACT EXCITATION OF Ca^{+}. Tully, J. A. (Instituto Astronomico e Geofisico, Sao Paulo, Brazil); Petrini, D.; Bely, O. Astron. Astrophys.; 23: No. 1, 15-17(Feb 1973).

The Coulomb Born approximation was used to compute collision strengths for electron impact excitation of the transitions 4s →

ns, np, nd and nf in Ca^+ with $5 \leq n \leq 10$. The results obtained for 4s → np are anomalous in the sense that they are of a predominantly nondipole character. This is explained by the abnormally small oscillator strengths for these allowed transitions. (auth)

11056 SATURATION EFFECTS IN FRAUNHOFER LINES OF NEUTRAL IRON. Cowley, C. R.; Toney, J. (Univ. of Michigan, Ann Arbor). Astron. Astrophys.; 22: No. 3, 441-443(Feb 1973).

The phenomena of saturation has been studied by comparing the ratios of theoretical intensities to equivalent width ratios. The study is confined to pairs of lines within the same multiplet. Empirical damping constants are obtained which are larger than those predicted by traditional theoretical treatments by about one order of magnitude. (auth)

11057 ZODICAL LIGHT PHOTOMETRY OF THE ECLIPTIC IN QUADRATURE AND IN OPPOSITION WITH THE SUN. Dumont, R. (Observatoire de Bordeaux); Sanchez-Martinez, F. Astron. Astrophys.; 22: No. 3, 321-328(Feb 1973). (In French).

Results are presented which were obtained from 1964 to 1971 at the Teide Observatory at Tenerife with a 30 cm-Cassegrain telescope. (WDM)

11058 ARE PENUMBRAL FILAMENTS CONVECTION ROLLS? Mullan, D. J. (Franklin Inst., Swarthmore, PA). Astron. Astrophys.; 24: No. 1, 103-105(Apr 1973).

The occurrence of strong magnetic fields in dark filaments in sunspot penumbrae is shown to be only marginally consistent with the hypothesis of penumbral convection rolls. Convection rolls are not permitted if the field in dark filaments exceeds that in bright filaments by more than 2%. The upper limit to this excess may be as small as 0.8%, if not in fact negative. (auth)

11059 HIGH-RESOLUTION SPACE-TIME STRUCTURE AND CENTER-LIMB DISTRIBUTION OF SOLAR TYPE I SOURCES OBSERVED AT 169 MHz. Bougeret, J. L. (Observatoire de Meudon, France). Astron. Astrophys.; 24: No. 1, 53-58(Apr 1973).

The one-dimensional brightness distribution over individual Type I solar bursts is studied with high time-resolution from photographic recordings and isophote plots (Nançay radioheliograph). Three main space-time shapes are distinguished according to the time-evolution of the brightness distribution peak: stationary (65%), drifting (15%), and split (0.4%). It is confirmed that the positions of Type I burst peak brightness lie within narrow regions of the storm center, and the following properties of Type I sources are pointed out: (i) A given source radiates bursts of persistent space-time shape over at least one or two hours; the distribution of the sources found over a three month active period is: stationary burst sources (70%), drifting burst sources (24%), split burst sources (6%). (ii) This space-time shape is strongly dependent on the E-W position of the source: stationary shape in the center of the disk, drifting shape on the limbs. (iii) The drift direction—toward Sun center or outward—is independent of the E-W position of the source. (iv) Sources of different shape-time shapes can coexist in the same noise center. An interpretation in which the space-time characteristics are attributed to propagation effects—excitation source real size much smaller than the observed size—could be relevant to these results. (auth)

11060 SIMULTANEOUS DETERMINATION OF THE ELECTRON TEMPERATURE AND DENSITY IN THE CHROMOSPHERIC-CORONAL TRANSITION REGION OF THE SUN. Malinovsky, M. (Laboratoire de Physique Stellaire et Planetaire, Verrieres-le-Buisson, France); Heroux, L.; Sahal-Brechot, S. Astron. Astrophys.; 23: No. 2, 291-294(Mar 1973).

The electron temperature and density in the solar atmosphere in the region of emission of OV were obtained from rocket measurements of euv spectral line intensity ratios. The experimentally determined temperature was in very good agreement with the emission temperature of the spectral lines of OV predicted by theoretical values of the ionization equilibrium ratio n(OV)/n(O). The experimental density, averaged over the entire solar disk, was also in good agreement with previous electron density measurements of the Harvard College Observatory. (auth)

11061 NUMERICAL METHOD FOR INVERTING A SINGLE ABSORPTION LINE PROFILE. Hearn, A. G.; Holt, J. N. (Univ. of Queensland, Australia). Astron. Astrophys.; 23: No. 3, 347-355(Mar 1973).

A numerical method of inverting a single absorption line profile is described. It determines the largest set of significant parameters which describe the atmosphere forming the line. The method is general in application, but it has been developed using a sodium D_2 line profile measured at the center of the disc of the Sun at high spatial resolution. The inversion of this line profile shows clear evidence of departures from local thermodynamic equilibrium, from which a mean electron density has been obtained for the region of the atmosphere forming the line core. With the addition of an absolute intensity or an independent temperature measurement the Voigt profile parameter, representing the mean pressure broadening, and the mean ratio of the continuous to line center opacity may be determined for the region of the atmosphere forming the wings of the line. The inversion shows that errors in estimating the pressure broadening in fitting observations to a model atmosphere will result in apparent microturbulence. The inversion provides an accurate determination of the continuum intensity for equivalent width measurements. The numerical method is quite stable in the presence of noise on the observed line profile. (auth)

Galaxies

Refer also to abstracts 10906, 10935, 10990, 11094, and 11648.

11062 MOLECULAR CLOUDS IN THE GALAXY. Buhl, D. (National Radio Astronomy Observatory, Greenbank, WV). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 9, 1198-1204(Sep 1973).

Spectral-line radio astronomy has revealed over 50 molecular lines in the past four years. These lines correspond to 24 interstellar molecules, mostly organic, which are contained in dust clouds. Molecular clouds play an essential part in the evolutionary cycle taking place in the Galaxy. (auth)

11063 LARGE-SCALE PECULIAR MOTION OF INTERSTELLAR GAS IN THE GALAXY. Ariskin, V. I. (Lebedev Inst. of Physics, Moscow). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 54-56(1973).

Translated from Astron. Zh.; 50: No. 1, 83-87(1973).

The possibility is demonstrated that the galaxy may contain large-scale expanding H I regions in the direction of the Sagittarius and Scutum arms. These regions are mainly responsible for the thermal background continuum radio emission received at 21-cm wavelength in this direction. The distance of the regions is ≈ 10 to 12 kpc; their average diameter, ≈ 2 kpc. They may have been produced by Type III "super-supernova" explosions that occurred in the galactic plane ≈ 10^7 yr ago. (auth)

11064 STABILITY OF GRAVITATING SYSTEMS WITH A QUADRATIC POTENTIAL. I. Systems Bounded in Phase Space: Oscillation Spectrum for a Maclaurin Stellar Disk. Polyachenko, V. L.; Shukhman, I. G. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 62-64(1973).

Translated from Astron. Zh.; 50: No. 1, 97-100(1973).

In this first paper of a series on the stability of gravitating systems with a quadratic potential, a method is proposed for investigating the behavior of small perturbations in systems that are bounded in phase space. The oscillation spectrum for a Maclaurin stellar disk is derived. (auth)

11065 FAST AND SLOW DENSITY WAVES IN SPIRAL GALAXIES. Mikhailovskii, A. B.; Fridman, A. M. Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 57-61(1973).

Translated from Astron. Zh.; 50: No. 1, 83-87(1973).

An explanation is offered for the observed "splitting" of spiral arms into branches containing red, yellow, and blue stars, in terms of a spiral density wave propagated across the plane of a gaseous disk. The direction of motion of the density wave is considered in a coordinate system referred to the rotating flat subsystem of a spiral galaxy. Waves moving toward the rotation are called "fast"; in the opposite direction, "slow". A homogeneous rotating cylinder is taken as a classic example of an axisymmetric system; in this case only slow density waves can develop. A criterion is derived for the formation of slow density waves in a flat rotating disk with an arbitrary radial dependence of angular rotation velocity and surface density. This criterion is found to coincide with the condition for trailing spirals. Observational evidence for the steady-state properties of flat subsystems indicates that the great majority of spiral galaxies satisfy this condition. Disks in solid-body rotation and with a large central mass are considered as special cases. Only slow density waves can form in the first case. In the second case slow waves will form if the density of the flat subsystem falls off more steeply with radius than $r^{-\frac{1}{2}}$; otherwise a fast wave can form in a narrow central region, accompanied by a leading spiral, but beyond it will revert to a slow wave. (auth)

11066 GALAXIES WITH AN ULTRAVIOLET CONTINUUM. IV. Markaryan, B. E.; Lipovetskii, V. A. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 299-310(1971).

Translated from Astrofizika; 7: No. 4, 511-519(1971).

The fourth list of galaxies having an ultraviolet continuum containing data for 99 objects is presented. The procedure described in the preceding articles of this series was applied in the case of

the observations and spectral investigations of faint galaxies. The notation in the lists remains unchanged. The presence of emission lines was detected or suspected for 65 objects of the 99 galaxies presented in this list. Fifty-two objects of the 99 are assigned to type s-sd; one can expect among them no more than 10 objects of the Seyfert type. But the presence of Seyfert peculiarities is predicted more or less certainly for four objects. The index numbers of 10 star-like objects which are assigned to be QSO candidates, based on the fact that they have a spectral energy distribution consistent with quasars, are indicated. (auth)

11067 MORPHOLOGY OF SOME MARKARYAN GALAXIES. Kalloglyan, A. T. (Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 7: No. 4, 311-316(1971).

Translated from Astrofizika; 7: No. 4, 521-528(1971).

A morphological study of some Markaryan galaxies featuring an ultraviolet continuum was carried out using plates taken with the 2-m telescope at the Tautenburg Observatory. Barred spiral galaxies are encountered more frequently than other Hubble type galaxies. The shape of the spectrum depends, according to Markaryan, on the morphological type of the galaxy. Spectra belong to type s (starlike) or to type d (diffuse) in the case of barred spirals and compact objects. (auth)

11068 OBSERVATIONS OF NEUTRAL HYDROGEN NEAR THE GALACTIC PLANE. Burton, W. B.; Verschuur, G. L. (National Radio Observatory, Green Bank, WV). Astron. Astrophys., Suppl. Ser.; 12: No. 2, 145-202(Nov 1973).

The 300 foot telescope of the National Radio Astronomy Observatory was used to obtain 21 cm line profiles of hydrogen emission near the galactic plane. The region $l \approx 15°$ to 225° was scanned at intervals of about 2° in latitude to an extent of about 20° on either side of the galactic equator. The reduced observations are presented as maps of antenna temperature contours in velocity–longitude coordinates. A number of constant longitude scans, cutting through the equator primarily in the first longitude quadrant, was also obtained. (auth)

11069 HIGH RESOLUTION OBSERVATIONS OF INTERSTELLAR NEUTRAL HYDROGEN: DATA TAKING AND PRESENTATION. Verschuur, G. L. (National Radio Astronomy Observatory, Green Bank, WV); Cram, T. R.; Giovanelli, R. Astron. Astrophys., Suppl. Ser.; 12: No. 2, 203-208(Nov 1973).

The data taking and reduction procedures for the 300 foot telescope observations of interstellar neutral hydrogen are described. (auth)

11070 HIGH-RESOLUTION STUDIES OF HIGH VELOCITY CLOUDS OF NEUTRAL HYDROGEN. Giovanelli, R.; Verschuur, G. L.; Cram, T. R. (National Radio Astronomy Observatory, Green Bank, WV). Astron. Astrophys., Suppl. Ser.; 12: No. 2, 209-262(Nov 1973).

High-resolution observations (10 minutes of arc, 1.37 km s^{-1}) of high-velocity clouds are presented. Examination of these data shows that the high-velocity gas has a hierarchial structure with small, bright condensations, typically less than 30 minutes of arc, embedded in larger regions of low emissivity. The velocity widths of the profiles associated with the diffuse component are typically 25 km s^{-1} while those associated with the small concentrations are typically 10 km s^{-1}. The masses of the two components are typically of the order of thousands and between 20 and 80 $M_\odot$ kpc^{-2} respectively. The high-velocity gas at intermediate- and high-galactic latitudes shows properties quite different from low-latitude, high-velocity objects and high-latitude, intermediate-velocity gas. Several cases of ring-like structures in the clouds were found. (auth)

11071 NEUTRAL HYDROGEN SURVEY OF THE ANDROMEDA NEBULA. Guibert, J. (Observatory, Meudon, France). Astron. Astrophys., Suppl. Ser.; 12: No. 2, 263-276(Nov 1973).

The neutral hydrogen in the Andromeda Nebula (M31) was investigated with the Nancay transit telescope. The purpose of the survey was to study the neutral hydrogen distribution and dynamics, and correlations between the gas and the main optical features of the galaxy. The resolution was 4′ in right ascension, 25′ in declination, and 12.7 km s^{-1} in velocity. At the distance of M31, 4′ corresponds to 800 pc, about the width of the spiral arms of the nebula as outlined by the H II regions. This paper presents the characteristics of the antenna pattern and the results of the survey in the form of maps of the H I distribution at constant velocities. (auth)

11072 NEUTRAL HYDROGEN STUDY OF 21 SMALL ANGULAR DIAMETER GALAXIES. Balkowski, C.; Bottinelli, L.; Gouguenheim, L.; Heidmann, J. (Observatoire, Meudon, France). Astron. Astrophys.; 23: No. 1, 139-143(Feb 1973).

Neutral hydrogen contents, systemic radial velocities, and indicative total masses of 21 galaxies with relatively small angular diameters from Sb to irregular types were measured with the Nancay radiotelescope. Determination of systemic radial velocities were made for 5 galaxies with previously unknown velocities; their group membership was confirmed, except for one of them. The effective neutral hydrogen diameters were determined for 6 galaxies. (auth)

11073 DETECTION OF H_2 FROM INTERSTELLAR CLOUDS IN THE WAVELENGTH RANGE 4.4μ TO 28.2μ. Bussoletti, E. (Observatoire, Meudon, France). Astron. Astrophys.; 23: No. 1, 125-129(Feb 1973).

The ir emissivities of the H_2 molecule in the range 4.4 to 28.2μ were calculated for two temperature ranges of astrophysical interest: 30°K to 300°K and 750°K to 10,000°K. The expected fluxes from the regions SgrA, SgrB2, Orion, (the HCN molecular cloud and the Kleinmann and Low nebula) ξ Per, and IC 1499, were calculated utilizing radio and uv data to estimate the temperature and H_2 densities. The results showed that some fluxes were higher than the detection threshold of the present ir detectors (normal N.E.P. $\simeq 4 \times 10^{-14}$W $Hz^{-\frac{1}{2}}$). It follows that the ir wavelength range 4.4 to 28.2μ is a good candidate for future search of molecular hydrogen. (auth)

11074 NEUTRAL HYDROGEN STUDY OF THE Scd-GALAXY NGC 4244. Huchtmeier, W. (Observatoire, Meudon, France). Astron. Astrophys.; 23: No. 1, 93-96(Feb 1973).

The late-type (Scd) galaxy NGC 4244 was observed in the 21 cm hydrogen line with the Nancay radio telescope using frequency resolutions of 330 and 60 kHz. Six per cent ($7 \times 10^9 M_\odot$) of the total mass of $1.2 \times 10^{11} M_\odot$ is in form of neutral hydrogen. An asymmetry in the mass distribution of H I was found; there is 20% more H I to the east of the optical center. No deviations from circular motions were noted. (auth)

11075 STATISTICAL INVESTIGATION OF NEUTRAL HYDROGEN LINE PROFILES. Baker, P. L. (National Radio Astronomy Observatory, Charlottesville, VA). Astron. Astrophys.; 23: No. 1, 81-92(Feb 1973).

Statistical parameters for two ensembles of observed hydrogen line profiles were derived and used to describe the turbulent state of the interstellar medium. It was found that the scale size of the turbulence was about 7 parsecs. Thermal and turbulent broadening was separated; the derived gas temperature was 5300° in the broad local component and 590° in the anticenter direction at b = −24°. The Mach number of the turbulence was of the order of unity. At l = 87.5°, b = 24.5°, where the line profile was asymmetric, the turbulence was anisotropic; the larger scale sizes moved predominantly inward indicating that the turbulence may arise in a flow or streaming motion. (auth)

11076 NEUTRAL HYDROGEN IN THE UNUSUAL DARK CLOUD, KHAVTASSI 713. Simonson, S. C. III. (Univ. of Maryland, College Park). Astron. Astrophys.; 23: No. 1, 19-23 (Feb 1973).

A prominent neutral hydrogen feature has been found to correspond in shape and position with the sharp-edged dark cloud, Khavtassi 713. The feature possesses an unusually strong velocity gradient in latitude, $dV/db = -2.7$ km s^{-1} deg^{-1}. As indicated both by stellar data and by its mean radial velocity of 21 km s^{-1}, the distance to Kh 713 is about 1 kpc. Its neutral hydrogen mass is then $\gtrsim 3400 M_\odot$; the kinetic energy associated with its velocity gradient is $\sim 2 \times 10^{47}$ erg; and its age is $\sim 6 \times 10^6$ y. Kh 713 resembles certain bright-rimmed dark clouds near H II regions, and this suggests that its velocity gradient resulted from interaction with an extinct H II region whose exciting stars no longer shine. Kh 713 may also be associated with an obscured H II region. (auth)

11077 PRESENCE OF H_2 MOLECULES INSIDE NEUTRAL GLOBULES IMBEDDED IN H II REGIONS. Stasinka, G. (Observatoire de Meudon, France). Astron. Astrophys.; 22: No. 3, 355-360(Feb 1973).

The abundance of the H_2 molecule in neutral globules inside H II regions was studied and the H_2 equilibrium abundances for different values of the incident radiation field, and of the globular mass, and density were computed. It is shown that, if one takes into account evolutionary effects, those globules that do not undergo gravitational collapse and remain unionized for a sufficiently long time are definitely molecular during the whole lifetime of the H II region. (auth)

11078 MODELS FOR EXTRAGALACTIC OBJECTS WITH VERY HIGH IR AND X-RAY LUMINOSITY. Bergeron, J.; Salpeter, E. E. (Cornell Univ., Ithaca, NY). Astron. Astrophys.; 22: No. 3, 385-406(Feb 1973).

Cases are considered where the x-ray luminosity is higher than (or about equal to) the (thermal) optical luminosity of the quasar or compact region of a galaxy. Two simple models which attempt to fit the observed data on both the x-ray and infrared emission are studied. (WDM)

11079 DISCUSSION OF THE NEW VARIATIONS OBSERVED IN THE NUCLEUS OF THE SEYFERT GALAXY NGC 3516. Collin-Souffrin, S.; Alloin, D.; Andrillat, Y. (Observatoire de Meudon, France). Astron. Astrophys.; 22: No. 3, 343-354(Feb 1973).

New spectroscopic observations (1970–1971) of the Seyfert galaxy NGC 3516 are presented. Through the comparison with previous observations (1967) performed in the same conditions, it is concluded that: an enhancement of the Balmer lines (the intensity is about four times larger); a decrease of the intensity of the [O III] line λ 4363; no variations of the continuum in the 4000–6000 Å. An attempt is made to explain such variations over a period of three years at most. The emissive region is composed of two or three different zones, with densities 10^3 to 10^4–10^5 cm^{-3} and masses from 2 to 200 $M_\odot$. A model with a clumpy distribution for the emissive gas accounts for the observed variations better than an homogeneous model (previously suggested by Souffrin, 1969a and b). A variable central source of uv radiation or more likely soft x rays provides the heating. The line variations can be explained by variations in the total numbers of emitting particles. The ionized regions must then contain neutral or weakly ionized matter. (auth)

11080 H I ABSORPTION IN THE GALACTIC CENTER REGION AND BETWEEN GALACTIC LONGITUDES 350° AND 359°. Kazes, I.; Aubry, D. (Observatoire de Meudon, France). Astron. Astrophys.; 22: No. 3, 413-420(Feb 1973).

Thirteen absorption profiles along the galactic center region as well as five in the region l^{II} = 350° to 359° are presented. Distance estimates were derived for radio sources in these regions. In particular, in the regions of the galactic center, relative abundances among HI, OH, and H_2CO are discussed in the light of the detected neutral gas in different molecular clouds. (auth)

11081 SEARCH FOR NEUTRAL HYDROGEN REMNANTS OF STRONG TIDAL DISRUPTION OF THE SMALL MAGELLANIC CLOUD. Mirabel, I. F. (Univ. Nacional, La Plata); Turner, K. C. Astron. Astrophys.; 22: No. 3, 437-440(Feb 1973).

A region of the sky in the south galactic hemisphere was observed in the 21 cm hydrogen line following a suggestion by Toomre that a "tail" of neutral hydrogen might exist, removed by gravitational interaction with the Galaxy, from the Small Magellanic Cloud during an earlier close encounter. No such regularly distributed material was observed, and an upper limit on the amount of such gas may be put as of the order of 1% of the amount of material in the bridge region of the Magellanic Clouds. (auth)

11082 BLACK-HOLE MODEL OF GALACTIC NUCLEI. Norman, C. A.; ter Haar, D. (Sterrewacht, Leiden). Astron. Astrophys.; 24: No. 1, 121-124(Apr 1973).

It is shown that the observed large infrared emission from some galactic nuclei finds a natural explanation, if one takes plasma turbulence into account in Lynden-Bell and Rees' black-hole model of galactic nuclei. (auth)

11083 HIGH-RESOLUTION NEUTRAL HYDROGEN STUDY OF THE GALAXY M 51. Weliachew, L. (Observatoire de Meudon, France); Gottesman, S. T. Astron. Astrophys.; 24: No. 1, 59-67(Apr 1973).

A 2 arc min synthesis study of the spiral galaxy M51 (NGC 5194) was made in the λ21 cm emission line of neutral hydrogen. A morphological H I symmetry axis was found at a position angle of 22° while the dynamically determined major axis was found at a position angle of −8°. The velocities in the northeast outer spiral structure were found to be strongly noncircular. They agreed in magnitude with predictions made by Toomre and Toomre for the tidal interaction between M51 and its companion galaxy NGC 5195. A possible continuation in neutral hydrogen of the outermost southwest spiral arm was detected. M51 also exhibited a strong deficiency in H I surface density at its center. An upper limit of 10^7 $M_\odot$ per beam area was placed on the neutral hydrogen content of the companion galaxy NGC 5195. This, in turn, yields an upper limit of ~0.1 for the distance-independent ratio M_{HI}/L_{pg}. (auth)

11084 IDENTIFICATION AND RADIO SPECTRA OF BRIGHT GALAXIES IN THE SECOND BOLOGNA CATALOGUE OF RADIO-SOURCES AND THEIR RADIO LUMINOSITY FUNCTION. Fanti, R. (Istituto di Fisica, Bologna); Gioia, I.; Lari, C.; Lequeux, J.; Lucas, R. Astron. Astrophys.; 24: No. 1, 69-78(Apr 1973).

Radio sources in the second Bologna Catalogue (Colla et al., 1970, 1972) were identified with galaxies in the Reference Catalogue of Bright Galaxies (G. and A. de Vaucouleurs, 1964) and in Vol. 2 and 3 of the Catalogue of Galaxies and of Clusters of Galaxies (Zwicky and Herzog, 1963, 1966); the two samples contain respectively 25 and 40 identified galaxies. These objects have been observed at 1415 MHz at Nancay to obtain their spectral indices between 408 and 1415 MHz. It is shown that intrinsically bright spiral galaxies are more likely to be radio emitters than the fainter ones, and the radio luminosity function is derived for spiral galaxies. Using various criteria, it is confirmed that there exist two classes of elliptical galaxies on the basis of their ratio properties, and the radio luminosity function for the galaxies with steep radio spectra is derived. (auth)

11085 ABSORBING MATERIAL IN THE ANDROMEDA NEBULA. van Genderen, A. M. (Leiden Observatory). Astron. Astrophys.; 24: No. 1, 47-51(Apr 1973).

A discussion is presented of the distribution of the absorbing material in the Andromeda Nebula, obtained with the aid of population I Cepheids in Baade's four variable-star fields. The absorption decreases towards the edge. The optical thickness of half of the absorbing layer, measured in blue light perpendicularly to the equatorial plane, is 0.20, 0.16, 0.12, and 0.10 mag in Fields I, II, III, and IV respectively. These absorptions are less than half of those in the galactic system around 10 kpc from the center. The mean blue absorption for the Cepheids in the association OB 78 = NGC 206 amounts to 0.53 mag. Except in Field I, the absorptions of the Cepheids SE of the major axis (i.e., on the far side of the nebula) are larger than for those NW of this axis, the difference increasing towards the edge. This is interpreted as indicating that in the regions investigated the dust is concentrated in the optical arms themselves rather than near their inner edges as is observed in some other spiral galaxies. The dust-to-gas ratio is found to be nearly equal to that in the Galaxy. (auth)

11086 INTERMEDIATE-NEGATIVE-VELOCITY GAS AROUND l = 128°, b = +75°. Wesselius, P. R. (Kapteyn Astronomical Lab., Groningen, Netherlands). Astron. Astrophys.; 24: No. 1, 35-39(Apr 1973).

The neutral hydrogen distribution, especially for intermediate-negative-velocities (INV, $-91 < V < -21$ km/s), has been studied in a region of about 10° × 10° centered at l = 238°, b = +75°. In most of the region INV gas is present. A number of subconcentrations can be distinguished. These subconcentrations, probably at a distance of 100 pc, have rather low densities and large velocity widths. Consequently they cannot be contained by a "normal" intercloud medium of 10^4 K. All the subconcentrations are probably parts of one large concentration. There appears to be a connection between this INV concentration and the low-velocity gas, indicating recent interaction between the two. (auth)

11087 INTERMEDIATE-NEGATIVE-VELOCITY NEUTRAL HYDROGEN AT B GREATER THAN OR EQUAL TO + 15°. Wesselius, P. R.; Fejes, I. (Kapteyn Astronomical Lab., Groningen Netherlands). Astron. Astrophys.; 24: No. 1, 15-34(Apr 1973).

The properties of intermediate-negative-velocity (INV) neutral hydrogen are described using the Groningen High Latitude Survey (GHLS, Tolbert, 1971). It is concluded that most of the INV gas at b > +30° occurs in a few large complexes and shows a systematic velocity pattern. The distribution of INV gas is compared to that of low-velocity (LV) and high-negative-velocity gas; the largest INV complex coincides roughly with a "hole" in the distribution of LV gas. Distance estimates for some of the INV complexes and one intermediate-positive-velocity complex are derived by comparing intermediate-velocity features of the K line of ionized calcium and the 21-cm line of neutral hydrogen. Two interpretations for the occurrence of such large INV complexes at high latitudes are discussed: a nearby supernova remnant and the interaction of a big gas complex with the galactic layer. The latter model is preferred. (auth)

11088 LARGE-SCALE DISTRIBUTION OF LOW-VELOCITY HYDROGEN GAS AT HIGH GALACTIC LATITUDES. Fejes, I.; Wesselius, P. R. (Kapteyn Astronomical Lab., Groningen, Netherlands). Astron. Astrophys.; 24: No. 1, 1-3(Apr 1973).

The distribution of low-velocity neutral hydrogen gas ($-21 < V < +15$ km/s) at latitudes $|b| \geq 15°$ is discussed on the basis of the Groningen High Latitude Survey (Tolbert, 1971). A number of strong neutral hydrogen ridges are described, some of which have not been noticed before. Comparison of the H I distribution with the spurs in the continuum radiation shows correlation in some cases but there is no convincing general correlation. The geometrical pattern of some of the ridges shows the existence in the solar neighborhood of a belt of low-velocity gas having a high inclination ($i \approx 45°$) with respect to the galactic plane. The pole of this belt is directed towards $l \sim 120°$, $b \sim +45°$. The estimated mass of this system, the "Scheve Schijf", is 5×10^4 $M_\odot$. The H I latitude distribution shows large and systematic deviations from the cosecant law. By model computations it is shown that these deviations are partly related to the highly inclined gas belt mentioned above. (auth)

11089 SCULPTOR GROUP. Lewis, B. M. (Australian National Univ., Canberra); Robinson, B. J. Astron. Astrophys.; 23: No. 2, 295-301(Mar 1973).

Results from high-resolution H I studies of five of the seven members of the Sculptor group are discussed. Using the masses derived from rotation curve studies and the improved systematic velocities of individual galaxies, the velocity of the mass centroid is found to be 224 km s^{-1}, the r.m.s. velocity dispersion is 149 km s^{-1} and the weighted dispersion is 91 km s^{-1}. The virial theorem overestimates the observed mass by a factor of ~28 rather than by > 100 found previously. A 3.0 ± 0.5 Mpc distance to the group is obtained from a rediscussion of the distance indicators. (auth)

11090 MANIFOLD OF GALAXIES. Galaxies With Known Dynamical Parameters. Brosche, P. (National Radio Astronomy Observatory, Green Bank, WV). Astron. Astrophys.; 23: No. 2, 259-268(Mar 1973).

For the sample of galaxies with known rotation curves the following independent integral properties were compiled: morphological type, photometric radius, radius and velocity of the maximum of the rotation curve, absolute luminosity, color, mass of neutral hydrogen. The main result of a component analysis is the presence of two significant dimensions in the sample. The relationships between the different variables indicate that the star formation rate is not a function of interstellar density alone. (auth)

11091 H I OBSERVATIONS OF COMPACT GALAXIES. Lauque, R. (Observatoire de Meudon, France). Astron. Astrophys.; 23: No. 2, 253-257(Mar 1973).

35 galaxies with velocities up to 6800 km/s, taken from Zwicky's seven lists of compact galaxies have now been observed at Nançay. From the 21-cm neutral hydrogen emission line flux detected in eight of these objects, it is shown that a high proportion of these compact galaxies with sharp emission line optical spectra is indeed hydrogen rich, though similar to late type galaxies. A possible instrumental selective effect is discussed. (auth)

11092 UP-TO-DATE PICTURE OF GALACTIC SPIRAL FEATURES BASED ON YOUNG OPEN STAR CLUSTERS. Moffat, A. F. J.; Vogt, N. (Ruhr-Univ., Bochum, Ger.). Astron. Astrophys.; 23: No. 2, 317-320(Mar 1973).

The number of young open star clusters previously studied with three-color photometry (Becker and Fenkart, 1971: 88) now stands at 110. Revisions for four clusters are given, of which Pismis 20 is especially interesting. This cluster coincides with the supernova remnant G 320.4 − 1.2 and the x-ray source 2 U 1509 − 58. The distribution of young clusters is compared with that of five other young spiral tracers out to ~4 kpc from the Sun. The most interesting features are: a filament protruding from the local arm at l = 270° and an abrupt discontinuation of the local arm beyond 1.6 kpc at l = 235°. (auth)

11093 OBJECT FOURCADE FIGUEROA, A SHRED ASSOCIATED WITH NGC 5128. Dottori, H. A.; Fourcade, C. R. (Observatorio Astronomico e IMAF, Cordoba, Argentina). Astron. Astrophys.; 23: No. 3, 405-409(Mar 1973).

The object Fourcade−Figueroa (F−F) (α_{50} = 13_h $32_m.5$; δ_{50} = −45 25′) has a total luminosity in the photographic m_{pg} = 12.14 and a corrected recession velocity of 830 km/s. The possibility is discussed that it is physically associated with the elliptic galaxy NGC 5128. (auth)

Cosmology

Refer also to abstracts 11007 and 11733.

11094 RELATIVISTIC VORTEX MOTION. Vainshtein, S. I.; Ruzmaikin, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Novosibirsk, USSR). Sov. Astron. AJ (Engl. Transl.); 17: No. 1, 7-10(1973).

Translated from Astron. Zh.; 50: No. 1, 12-18(1973).

A general-relativity equation for a vortex is derived for a fluid in isentropic motion, generalizing the Helmholtz equation, and an integral theorem is established that is equivalent to a velocity-circulation theorem proved earlier in relativistic hydrodynamics. It is concluded that vortical motions cannot develop from irrotational motions in an isentropic fluid. The possibility of a relativistic vortex "dynamo" is discussed. (auth)

11095 ISOTROPY OF THE X-RAY BACKGROUND RADIATION. Brecher, K. (Univ. of California, San Diego). Astron. Astrophys.; 23: No. 1, 105-110(Feb 1973).

The spatial fluctuations expected for various models of the x-ray background radiation are examined. The constraints that observations place on the source distribution and radiation mechanisms are then presented. Most models are at present consistent with the lack of observed small scale anisotropy. Future measurements of the beam-to-beam fluctuations could offer a positive test of the inverse Compton explanation for the origin of the x-ray background radiation. (auth)

11096 DEPENDENCE OF THE INTEGRATED BACKGROUND LIGHT ON COSMOLOGY, GALACTIC SPECTRA, AND GALACTIC EVOLUTION. Tinsley, B. M. (Univ. of Texas, Dallas). Astron. Astrophys.; 24: No. 1, 89-98(Apr 1973).

The theoretical spectrum and intensity of the integrated light of distant galaxies are studied as a function of uncertain parameters entering their calculation. These include the cosmological model, epochs of formation of galaxies, evolution of the magnitudes and colors of galaxies of different types, the ultraviolet radiation of galaxies, and the local luminosity density of the Universe. It is found that the background light is affected strongly by all of these factors, in such a way that even highly penetrating observational data could yield little firm information for either cosmology or galactic evolution. If better estimates of these parameters than those presently available are obtained from other considerations, measurements of the background light could provide an important test of their consistency. (auth)

Planetary Phenomena

11097 (N-73-24486) GAMMA-RAY SPECTROMETER EXPERIMENT, APOLLO 17: NaI(Tl) DETECTOR CRYSTAL ACTIVATION. Preliminary Science Report. Trombka, J. I.; Schmadebeck, R. L.; Bielefeld, M.; OKelley, G. D.; Northcutt, K. J.; Metzger, A. E.; Arnold, J. R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Mar 1973. 10p. (NASA-TM-X-66241). NTIS $3.00.

11098 (N-73-24845) VANADIUM ISOTOPIC COMPOSITION AND CONCENTRATIONS OF FERROMAGNESIAN ELEMENTS IN RETURNED LUNAR SAMPLES. Final Report. Lipschutz, M. E. (Purdue Univ., Lafayette, Ind. (USA)). Apr 1973. 4p. (NASA-CR-132045). NTIS $3.00.

The effects are sought of an energetic charged particle irradiation of solar system material which is postulated as having taken place early in its history. A similar irradiation took place much more recently in the history of lunar samples and meteorites and this process is studied by means of a variety of monitors including highly sensitive noble gas nuclides, radionuclides, and tracks. Such monitors cannot be used to study the postulated early irradiation since it could have taken place under conditions such that these monitors were not retained or were subsequently lost. Accordingly, it is necessary that a nongaseous element be used to search for the effects of this irradiation, and one of the most sensitive of these is the vanadium isotopic composition. A comparative study is made of the $^{50}V/^{51}V$ ratio in 15 meteoritic, 5 terrestrial, and 11 lunar samples. (auth) (STAR)

11099 (N-73-28824) ANALYSES OF GAMMA-RAY PULSE-HEIGHT SPECTRA FROM THE LUNAR SURFACE. Trombka, J. I. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1973. 20p. (NASA-TM-X-70421). NTIS $3.00.

The method of inferring photon spectra from an analysis of the measured pulse-height spectrum is considered along with the spectrum shape and its variation energy. The case is examined where photoelastic absorption predominates, and Compton scattering and pair production are negligible. The analytic method for obtaining the elemental composition from the observed lunar surface spectrum is described, and theoretical and calculated weight fraction fluxes for average lunar composition are tabulated. (STAR)

11100 NOBLE GAS ABUNDANCE PATTERNS IN DEEP-SEA BASALTS-PRIMORDIAL GASES FROM THE MANTLE. Dymond, J.; Hogan, L. (Oregon State Univ., Corvallis). Earth Planet. Sci. Lett.; 20: No. 1, 131-139(Sep 1973).

Rapidly cooled portions of eleven samples of mid-ocean ridge tholeiitic basalt pillows have noble gas abundance patterns which resemble the solar rare gas pattern rather than the noble gas pattern of the terrestrial atmosphere. It is concluded that these samples contain primordial noble gases. In contrast, holocrystalline samples and a sample from the interior of a basalt pillow have noble gas abundance patterns which resemble the sea water pattern. Whereas the quenched glossy margins of basalt pillows record a nonatmospheric gas reservoir, these slowly cooled samples apparently have undergone exchange of their noble gases with those dissolved in sea water. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 11109.

11101 (N-73-21342) PROPAGATION STUDIES USING A THEORETICAL IONOSPHERE MODEL. Lee, M. K. (Pennsylvania State Univ., University Park (USA). Ionosphere Research Lab.). 1 Mar 1973. 150p. (NASA-CR-131547; PSU-IRL-SCI-408). NTIS $9.50.

The mid-latitude ionospheric and neutral atmospheric models are coupled with an advanced three dimensional ray-tracing program to see what success would be obtained in predicting the wave propagation conditions and to study to what extent the use of theoretical ionospheric models is practical. The Penn State MK 1 ionospheric model, the Mitra–Rowe D-region model, and the Groves' neutral atmospheric model are used throughout this work to represent the real electron densities and collision frequencies. The Faraday rotation and differential Doppler velocities from satellites, the propagation modes for long-distance high-frequency propagation, the group delays for each mode, the ionospheric absorption, and the spatial loss are all predicted. (auth) (STAR)

11102 METHOD OF STUDYING MAGNETIC-IONOSPHERIC DISTURBANCES AND SOLAR FLARE EFFECTS ON LONG-UP-SET PERIODS. Serafimov, K. B. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 631-634(1973).

A method is described for determining the concept of a calm normal state of ionization and electron density in the ionosphere. (WDM)

11103 AURORA. Heikkila, W. J. (Univ. of Texas, Dallas). EOS, Trans., Amer. Geophys. Union; 54: No. 8, 764-768(Aug 1973).

A brief review is given on auroral and magnetospheric phenomena. (WDM)

Magnetospheric Phenomena

11104 (N-73-20840) ESTIMATES OF TRAPPED RADIATION ENCOUNTERED ON LOW-THRUST TRAJECTORIES THROUGH THE VAN ALLEN BELTS. Karp, I. M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 17p. (NASA-TM-X-2777; E-7341). NTIS $3.00.

Estimates were made of the number of trapped protons and electrons encountered by vehicles on low-thrust trajectories through the Van Allen belts. The estimates serve as a first step in assessing whether these radiations present a problem to on-board sensitive components and payload. The integrated proton spectra and electron spectra are presented for the case of a trajectory described by a vehicle with a constant-thrust acceleration A_c equal to 0.001 meter/sq sec. This value of acceleration corresponds to a trip time of about 54 days from low Earth orbit to synchronous orbit. It is shown that the time spent in the belts and hence the radiation encountered vary nearly inversely with the value of thrust acceleration. Thus, the integrated spectral values presented for the case of $A_c = 0.001$ meter/sq sec can be generalized for any other value of thrust acceleration by multiplying them by the factor $0.001/A_c$. (auth) (STAR)

11105 (N-73-20842) MODEL OF THE STARFISH FLUX IN THE INNER RADIATION ZONE. Teague, M. J.; Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Dec 1972. 66p. (NASA-TM-X-66211). NTIS $5.50.

A model of the Starfish electrons injected into the radiation belt in July 1962 was determined for epoch September 1964. This model distinguishes between artificial and natural electrons and provides the artificial unidirectional electron flux as a function of equatorial pitch angle, energy, and L value. The model is based primarily upon data from the OGO-1, OGO-3, OGO-5, 1963-38C, and the OV3-3 satellites. Decay times for the starfish electrons are given as a function of energy and L value. These decay times represent the best compromise between a number of independently determined values. The times at which the artificial Starfish flux component had become insignificant in comparison to the natural flux component are determined as functions of energy and L values. These times are determined by two separate methods, and averaged values are presented. It is shown that Starfish electrons, by the present time, have become insignificant for all energies and L values. (auth) (STAR)

11106 (N-73-23754) NONLINEAR INTERACTION OF A FAST MAGNETOGASDYNAMIC SHOCK WITH A TANGENTIAL DISCONTINUITY. Neubauer, F. M. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). 1973. 47p. NTIS $4.50.

A basic problem, which is of considerable interest in geoastrophysical applications of magnetogasdynamics, is the nonlinear interaction of a fast shock (S_f) with a tangential discontinuity (T). The problem is treated for an arbitrary S_f interacting with an arbitrary T under the assumption that in the frame of reference in which S_f and T are at rest, the flow is superfast on both sides of T, and that a steady flow develops. As a result of the nonlinear analysis a flow pattern is obtained consisting of the incident discontinuities S_{f1} and T2 and a transmitted fast shock S_{f3}, the modified tangential discontinuity T4 and a reflected fast shock S_{f5} or fast rarefaction wave R_{f5}. The results are discussed in terms of seven significant similarity parameters. In addition special cases like changes in magnetic field direction only, changes in density or velocity shear only etc. are discussed. (auth) (STAR)

11107 (N-73-23814) ERTS/NIMBUS RADIATION ENVIRONMENT INFORMATION. Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Apr 1973. 96p. (NASA-TM-X-66236). NTIS $4.00.

The results of the ERTS/Nimbus satellite investigation of electron flux levels are presented. Flux calculations were made with the use of two electron environment models, both of which are static and describe the environment during the solar maximum conditions of October 1967. It is concluded that the construction of these models makes it possible to infer a change of the average quiet time electron flux levels as a function of the solar cycle. (STAR)

11108 REPRESENTATION OF THE SEMI-ANNUAL VARIATION OF THE GEOMAGNETIC ACTIVITY BY AN ANNUAL SINE WAVE. Houtgast, J.; Van Sluiters, A. (Astronomical Inst., Utrecht). Solar Phys.; 31: No. 2, 513-524(Aug 1973).

The seasonal variation of the geomagnetic activity shows two sharp maxima (in March and September) and two broader minima (in June and December). It can only poorly be described by a double sine wave. The double phase wave of geomagnetic activity can be transformed—by vertical mirroring of the half year part between the maxima—into a single phase wave, which is represented well by a single sine function. This function is determined for C_i (the daily international character figure of geomagnetic activity) and for A_p (the equivalent daily amplitude, based on K_p, the geomagnetic planetary three-hour-range indices), for both in their ratios to the mean value over the year and then averaged over many years. To remove part of the irregularities the daily values of C_i and A_p were corrected for solar activity and reduced to quiet Sun circumstances. Mirroring back to the double phase function the geomagnetic variation is then represented by $C_i(\text{or } A_p) = C_m(\text{or } A_{p,m}) - |A \sin(\lambda - \varphi)|$, in which m means the mirror value, A is the amplitude of the single sine curve, λ runs parallel to the Sun's longitude, φ is the phase constant and the bars indicate the absolute value. The data of the first maximum of the seasonal variation was found to vary between March 18 and 28 for different groups of years. The sharpness of the maxima may point out a resonance in the interaction between the solar wind and the magnetosphere. The relation $C_i = aR^b + b$ (R being the relative sunspot number) is brought forward. The values of the parameter b through the eleven-year period reveal an increasing influence of sunspot-free regions towards the minimum. (auth)

11109 POTENTIAL OSCILLATIONS WITH FREQUENCIES, EXCEEDING GYROFREQUENCY, IN PLASMA WITH LOSS CONE. Alekhin, Yu. K.; Borisov, N. D.; Karpman, V. I. (Inst. of Terrestrial Physics, Ionosphere, and Radio-Wave Propagation, Moscow). Dokl. Akad. Nauk SSSR; 210: No. 6, 1317-1319(21 Jun 1973). (In Russian).

Reports have appeared on potential oscillations with frequencies close to $(n + \frac{1}{2})\,\omega_c$, where ω_c is the electron cyclotron frequency, and $n = 1, 2 \ldots$. These oscillations were registered, for example, in the equatorial region of the Earth's magnetosphere, and also in probing the ionoxphere above. In theoretical studies, the generation of these waves is associated with the presence of a loss cone. Results are given on an analytical study of the kinetic instability and propagation conditions of waves in this range of frequencies at values of the electron cyclotron frequency modified by the longitudinal thermal electron velocity. The electron distribution function and the dispersion equation for the potential oscillations are presented. (SJR)

11110 NONLINEAR DEVELOPMENT AND FOURIER ANALYSIS OF THE WHISTLER MODE INSTABILITY. Cuperman, S. (National Oceanic and Atmospheric Administration, Boulder, CO); Salu, Y. J. Plasma Phys.; 9: 295-310(Jun 1973).

The results of a nonlinear computer investigation of the whistler mode instability with the aid of particle-in-cell simulation methods are presented. The electron plasma considered is hot, anisothermal, and embedded in a static magnetic field. A detailed Fourier analysis of the electromagnetic activity developed is carried out. The waves are shown to be electron-like, and agreement with the linear-stability analysis for the first stages of evolution is found. The feedback effect of the waves on the particles is shown to result in a continuous decrease of the thermal anisotropy ratio. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 9833–9838, 9840, 9843, 10713, 10831, 11168, 11169, 11658, and 12457.

11111 (CONF-720948-) PROCEEDINGS OF THE SECOND INTERNATIONAL CONFERENCE ON ION SOURCES HELD IN VIENNA, AUSTRIA, SEPTEMBER 11–15, 1972. Viehboeck, F.; Winter, H.; Bruck, M. (eds.). (Technische Hochschule, Vienna (Austria). 2. Inst. fuer Experimentalphysik). 1972. 950p.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The conference included 100 papers 15 of which were abstracted previously in NSA. For abstracts of these papers see CONF-720948 in a cummulative report number index. Separate abstracts were prepared for 71 papers. Other papers were outside the subject scope of NSA. (JFP)

For abstracts of individual papers see: 10283, 10291, 10305, 10802, 10803, 10812, 10823–10835, 10842, 10843, 11112–11157, and 11168–11171.

11112 (CONF-720948-, pp 1-16) ION–MOLECULE REACTIONS. Hasted, J. B. (Birkbeck Coll., London). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The production of atomic and molecular ions by inelastic ion–molecule collisions at thermal and suprathermal energies which operate in plasma ion sources and at higher energies appropriate to conversion of ion beams in gas collision cells is reviewed. (JFP)

11113 (CONF-720948-, pp 92-97) NEUTRAL GAS ANALYSIS BY A HOLLOW CATHODE ION SOURCE. Howorka, F. (Univ., Innsbruck). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

It was shown that simply changing the potential of a sampling probe permits determination of the neutral gas proportions in the discharge like in a conventional electron impact ion source. As the electron energy distribution is unknown, a calibration was necessary for which various Ar–H_2-mixtures were used. The results show an error of ±30%. The H_2O content was measured in some Ar–H_2-mixtures. (auth)

11114 (CONF-720948-, pp 98-104) OBSERVATION OF SHORT LIVING NEGATIVE METASTABLE ION TRANSITIONS IN A PULSED SOURCE. Platzner, I.; Levin, G. (Nuclear Research Center Negev, Beer-Sheva, Israel). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A pulsed ion source was constructed to operate with a 60° magnetic sector mass-spectrometer. With this arrangement: kinetics of ion-molecule reactions, ion kinetic energy excess due to the ionization processes and metastable transitions were studied. Limitation is made to the applications of the method for primary processes occurring upon electron impact. The kinetic aspects of the pulsed source technique are summarized briefly. (auth)

11115 (CONF-720948-, pp 111-132) SOME REMARKS ON EMITTANCE AND BRIGHTNESS OF ION SOURCES. Walcher, W. (Univ., Marburg, Ger.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The questions whether it is plausible to specify an emissive surface in the case of a plasma ion source and how to define the emittance of this surface are answered. Also the concepts of brightness of the source and the beam are examined with particular attention to the exact definitions of the relevant quantities. (JFP)

11116 (CONF-720948-, pp 133-145) POSSIBLE ION BEAM QUALITY DETERIORATION DUE TO NON LINEAR SPACE CHARGE EFFECTS. Lapostolle, P. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France). 1972

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The discussion covers the definition of root mean square emittances, the growth of rms emittances, and generalization to three dimensions and entropy. (JFP)

11117 (CONF-720948-, pp 146-152) BEAM EMITTANCE AND BRIGHTNESS AS A FUNCTION OF PHASE SURFACE GEOMETRY. Prevot, F.; Becherer, R. (CEN, Fontenay-aux-Roses, France). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

It is shown that the relation between current, brightness, and emittance has to be calculated for every beam geometry. In order to determine the brightness of a beam of particles it is necessary to know not only the value of the emittance but also the shape of the emittance diagram and to use an adequate formula. In practice the shape of the emittance diagram is obtained by experimental measurement of the emittance. (JFP)

11118 (CONF-720948-, pp 153-159) MEASUREMENTS OF A TRANSVERSAL ENERGY OF AN ION BEAM EXTRACTED FROM A REFLEX DISCHARGE. Kulygin, V. M.; Semashko, N. N. (Inst. of Atomic Energy, Moscow). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The transverse thermal spread in an intensive ion beam extracted from a Calutron type ion source was studied. It was found that the ion transverse energy spread value depends on discharge conditions and dimensions and orientation of the extracting slit. Discharge plasma instabilities influence the effective spread. A boundary condition contribution is essentially connected with discharge instabilities which apparently break an emission surface stability. (JFP)

11119 (CONF-720948-, pp 160-167) ION-OPTICAL EFFECTS IN THE EXTRACTION OF POSITIVE IONS FROM AFTERGLOW PLASMAS. Zwirner, W. (Technische Universitaet, Brunswick). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

By means of a plane probe positive ions are extracted from flowing–afterglow plasmas of pure N_2 and He–N_2 mixtures through a collision-dominated space-charge sheath. Both the electric field strengths within the sheath and behind the extraction holes strongly influence the extraction efficiency. The variation of the extracted ion currents with the field strengths is partly explained by an ion-optical behavior. (auth)

11120 (CONF-720948-, pp 168-175) BEAM DIVERGENCE FROM A SINGLE APERTURE THREE ELECTRODE ACCEL–DECEL EXTRACTION SYSTEM. Coupland, J. R.; Riviere, A. C. (Culham Lab., Abingdon, Eng.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

An experimental investigation into the various parameters which affect the divergence of the beam from a single aperture extraction system is described. The aim was to determine the optimum design for a single aperture system for use in future multi-aperture sources, and this has influenced the range of parameters covered. The complication of varying ion mass was avoided by using helium. The results have shown that the maximum current from a multi-aperture array would be obtained for a ratio of first aperture radius to gap length less than about 0.5. (auth)

11121 (CONF-720948-, pp 271-277) ELECTRODE HEAT DISSIPATION LIMITS ON MULTI-APERTURE ION SOURCE PERFORMANCE. Cole, H. C.; Hammond, D. P.; Jones, E. M.; Riviere, A. C.; Sheffield, J. (Culham Lab., Abingdon, Eng.). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The dissipation of heat in the electrodes of multi-aperture ion sources is a major factor in limiting the power output and beam pulse duration. The results of a series of tests on multi-aperture and single aperture arrays are used as the basis for the derivation of formulas which define the limits of the practical operating regime for a single edge cooled electrode element. (auth)

11122 (CONF-720948-, pp 289-295) LARGE AREA ION SOURCE. Fumelli, M.; Becherer, R.; Bergsten, L.; Valckx, F. P. G. (CEN, Fontenay-aux-Roses, France). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

The design and performance of a large area prototype ion source is described. The device was designed in order to improve the plasma homogeneity and to increase the extraction surface up to 10 cm in diameter. The plasma density versus the discharge current and the extracted ion current density profile are shown. (JFP)

11123 (CONF-720948-, pp 296-302) STUDIES OF ELECTRON–ION OSCILLATORY DISCHARGE AS A SOURCE OF IONS AND NEUTRAL PARTICLES. Rashkovan, V. M.; Khizhnyak, N. A.; Lymar, A. G. (Physical-Technical Inst., Kharkov). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

Plasma ion sources with a Penning discharge are described. The discharge chamber, magnetic field, ion motion, discharge current, the shape of the plasma formation boundary, and ion beam parameters are discussed. The currents of singly and doubly charged nitrogen ions as a function of voltage, the extracted ion energy spectra, and the neutrals current and energy spectra are shown. (JFP)

11124 (CONF-720948-, pp 303-308) ELECTRON SHEET BEAM EXTRACTION OF IONS FROM A PLASMA. Grodzinsky, S.; Hendricks, C. D. (Univ. of Illinois, Urbana). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A Pierce gun is used to extract ions from a magnetron initiated plasma. The extracted ion current is described. (JFP)

11125 (CONF-720948-, pp 309-315) EXTRACTION OF INTENSE ION BEAMS FROM A HOT ELECTRON PLASMA. Okamoto, Y.; Tamagawa, H.; Takayama, K. (Nagoya Univ., Japan). 1972.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A hot electron plasma ion source was produced with a proton beam up to 0.5 A at steady state operation with low energy less than 1 keV. The hot and large uniform plasma is produced by means of Lisitano coils in the electron cyclotron resonance condition. The 4 cm diam extraction electrodes are multiple apertures and are arranged in an accel-decel configuration. The beam is composed of 92% atomic ions, of which either the molecular or triatomic component can be maximized by the adjustment of electron temperature. (auth)

11126 (CONF-720948-, pp 325-366) PLASMA IN ION SOURCES. Wiesemann, K. (Univ., Marburg, Ger.). 1972.

From second international conference on ion sources, Vienna, Austria (11 Sep 1972).

Ion sources are considered as a means of transferring energy from an external generator into the ionization degree of freedom of a material medium. In the case of a plasma ion source, an electrical power supply couples to the free electrons of the plasma. The free electrons ionize the neutrals. Loss mechanisms and the ion beam transport ionization energy away from the plasma. The coupling conditions and the loss processes in the three stage process of energy delivery to electrons, ionizing collisions and ion beam generation are considered, and the possibilities for optimizing these couplings are discussed with regard to some special types of discharges. It is shown that optimal design of an ion source means, in most cases, optimal tailoring of the electron distribution function. (auth)

11127 (CONF-720948-, pp 367-373) DYNAMIC CHARACTERISTICS OF THE KYOTO BEAM-PLASMA TYPE ION SOURCE. Takagi, T.; Yamada, I.; Ishikawa, J.; Iwao, H. (Kyoto Univ.).1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Fundamental study is made of the phenomena of the beam–plasma interactions and discharge which enhance the ionization in the drift space and the collector region of a new beam–plasma type ion source. Also some characteristics of the ion current and the multiply charged ions are presented. (JFP)

11128 (CONF-720948-, pp 374-379) PHYSICAL NATURES OF THE BPD ION SOURCE. Nunogaki, M.; Akimune, H.; Suita, T. (Osaka Univ.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The source plasma is produced by means of electron beam–plasma interaction. Some experimental approaches indicate that the beam perveance increases by a factor compared to the case of the space charge limit of current and that the form of boundary surface can be controlled by use of multi-electron-beam gun. Preliminary experiments indicate that this type of ion source may make possible the ion extraction through a single aperture of a large diameter. (auth)

11129 (CONF-720948-, pp 380-386) TPD PLASMA SOURCE AS A GIANT ION SOURCE. Otsuka, M.; Ishii, K.; Takayama, K. (Nagoya Univ., Japan). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Preliminary experiments which show the applicability of the TPD plasma source as a high current ion source are discussed. (JFP)

11130 (CONF-720948-, pp 387-394) STUDY OF THE OSCILLATIONS IN THE DUOPLASMATRON ION SOURCE. Lejeune, C. (Univ. Paris, Orsay, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The main results which are important in ion beam operation, that is, the vibrations which influence seriously ion beam focusing, are presented for a simultaneous study of the physical processes governing the behavior of the discharge and of the generation mechanisms of the oscillations for the duoplasmatron. (JFP)

11131 (CONF-720948-, pp 402-408) SOME PROPERTIES OF VACUUM ARC ION SOURCES. Owen, W. D.; Richardson, M. (Atomic Weapons Research Establishment, Aldermaston, Eng.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Some investigations of the properties of vacuum arcs between deuterated erbium film electrodes deposited on a ceramic substrate used as ion sources are presented. A diffuse mode of current collection existed at the anode and therefore the investigations were concerned with plasma generated at cathode hot spots. The results suggest that the motion of the ions from the source was radial with little scattering. The mean expansion velocity and temperature of the plasma at 6 cm from the source were 1 cm/μsec and $\simeq$7 eV respectively. Preliminary measurements showed the ionic constituents of the plasma to include singly, doubly, and triply ionized erbium with maximum energies $\simeq$600 eV. (JFP)

11132 (CONF-720948-, pp 409-420) ENERGY DISTRIBUTION OF IONS FROM A HIGH FREQUENCY SOURCE. Hurley, R. E.; Holland, L. (Edwards High Vacuum International, Crawley, Eng.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The energy distribution of the extracted ion beam from an r.f. ion source operating in a silica envelope was studied using parallel plate and 127° energy analyzers. Both capacitative and inductive input coupling electrode systems were investigated. The results show for He, Ar and Kr that a main energy peak at a voltage slightly less than the extraction voltage is obtained with a resolved low energy region appearing at high gas pressures or high d.c. extraction potentials. The low energy region is attributed to ions formed in the extraction region by secondary electrons released by positive ion bombardment of the walls of the extraction canal. Thus the beam is composed of ions formed in and extracted from the plasma with peak energies approaching the applied d.c. voltage and ions formed in the extraction positive sheath region as occurs in a cold cathode discharge. A second peak is also observed with hydrogen but this occurs at a voltage approximately 500V greater than the applied extraction potential. The peak could arise from energetic neutral atomic hydrogen being formed in the source e.g., by neutralization of protons that are energetically reflected from walls, reionized and are subsequently extracted by the d.c. field. However, charge exchange collision processes could also be important, and it will be necessary to resolve the component masses of the extracted beams to answer these questions. (auth)

11133 (CONF-720948-, pp 421-436) SPACE CHARGE NEUTRALIZATION OF ION BEAMS. Dolique, J. M. (Univ., Grenoble, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The lecture on space charge neutralization of ion beams covers the origin of this neutralization, and self-neutralization and forced neutralization. (JFP)

11134 (CONF-720948-, pp 437-443) COMPUTATIONAL STUDY OF HYPERSONIC ION BEAM NEUTRALIZATION. Pomot, C.; Cohen, J. (Univ., Grenoble, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

In order to understand the neutralization processes by thermal electrons of a hypersonic ion beam a one-dimensional model similar to that of Whadwa and Kooyers "Analysis of Electron–Ion Mixing in Ion Engines", N.A.S.A. Contract–NAS 3-2503(1964). The electron phase trajectories and the time evolution of the electric field in the front are studied. (JFP)

11135 (CONF-720948-, pp 444-449) DAMPING OF THE LARGE AMPLITUDE WAVE EXCITED DURING PLASMA BEAM SYNTHESIS. Pomot, C. (Univ., Grenoble, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The stability of the large-amplitude wave-trapped particles system excited during plasma beam synthesis is studied. (JFP)

11136 (CONF-720948-, pp 527-534) POSSIBILITY OF CREATION OF AN AXIAL WELL TRAPPING POSITIVE IONS IN THE CENTER OF THE ANODE OF A MULTICHARGED ION

SOURCE. Makov, B. N. (Inst. of Atomic Energy, Moscow). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A higher content of multicharged ions can be obtained if an axial potential well for positive ions is created. Such a well in the magnetically supported plasma column of a reflex discharge can be produced between two regions of higher concentrations of plasma made of the atoms of condensing material. (JFP)

11137 (CONF-720948-, pp 549-558) PRODUCTION OF HIGHLY CHARGED IONS OF DIFFERENT ELEMENTS IN DUOPLASMATRON AND COLD CATHODE PENNING SOURCES. Schulte, J.; Illgen, J.; Wolf, B. H. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The production of metal ions in a duoplasmatron was studied to determine the mean charge as a function of the furnace temperature, the relative yield of Bi and Ar as a function of temperature, and the oven-temperature dependence of the total particle current, the total Bi current, and the particle current of Bi^{5+} were found. Also the production of highly charged metal ions was studied in a cold cathode Penning source. The result was that this source is not very suitable for vaporized materials. (JFP)

11138 (CONF-720948-, pp 577-585) PENNING ION SOURCE FOR MULTIPLY CHARGED HEAVY IONS. Baumann, H.; Heinicke, E.; Bethge, K. (Univ., Heidelberg). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The dependence of the total extracted ion current from the Penning ion source on the arc voltage, the magnetic field, and the gas flow into the discharge is studied. Results of the study are given graphically. (WHK)

11139 (CONF-720948-, pp 586-596) IONIZATION PROCESSES IN HEAVY ION PLASMAS CREATED BY LASER IMPACT. Colombant, D.; Perez, A.; Tonon, G. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A review is made of the various ionization and recombination mechanisms which take place in heavy ion plasmas at high temperatures. In such plasmas, the collisional ionization and the radiative recombination are the major processes. The ionization equation which then follows these assumptions is solved for the stationary state. However, laser produced plasmas have short life time (a few nsec) and their lifetime is compared to the characteristic times of ionization relative to each state of charge. This allows one to evaluate the highest state of charge which can be reached, given the electron temperature of the plasma $Z = k T_e^{3/2}$. The temperature being related to the laser flux Φ through a model which takes into account the hydrodynamic motion of the plasma, one can then relate the variation of Z to the laser flux density. Results of these computations are in good agreement with some experimental results obtained on different target materials into fluxes ranging from 10^{10} to 10^{12} W/cm^2. (auth)

11140 (CONF-720948-, pp 597-608) ANALYSIS OF Al^{13+} AND Fe^{24+} IONS CREATED BY LASER IMPACT. Perez, A.; Rabeau, M.; Tonon, G. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Very highly charged ions are produced in the plasmas created by the impact of powerful lasers on plane targets located in a vacuum of 10^{-6}. Some experimental evidence of these ions (Al^{13+}, Fe^{24+}) is given by a selection in W/Z performed with an electrostatic analyzer coupled to a flight-time basis of 1,2 m. Through the use of charge collectors it is also shown that the mostly charged ions are emitted in a cone with an opening angle of a few degrees only. When leaving the plasma, the ions have average energies of several keV. The main characteristics of the ion emission are presented: total numbers energy distribution, average velocity, angular distribution. The variation of the ions state of charge for laser fluxes between 10^9 and 10^{13} W/cm^2 is also given. (auth)

11141 (CONF-720948-, pp 609-619) LASER ION SOURCE: SOME POSSIBILITIES FOR IMPROVEMENT. Bajard, M. (Univ. Lyon, Villeurbanne, France); Chabert, A.; Tauth, T.; Perez, A.; Tonon, G. 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Taking into account the characteristics of laser produced plasmas, some ways for shaping a beam out of this plasma are proposed. A rough analysis of such phenomena as time decoupling between ionic and electronic components, charge exchange processes, and energy spread is given. A system which might lead to highly charged ion pulses of the order of tens of microseconds, suitable for injection into heavy ion accelerators is described. (auth)

11142 (CONF-720948-, pp 620-631) SOME RESULTS ABOUT ION SOURCES IN INHOMOGENEOUS MAGNETIC FIELDS. Tauth, T.; Hadinger, G.; Hadinger-Espi, G.; Bajard, M. (Univ. Lyon, Villeurbanne, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

In order to guess the yield of multicharged heavy ion sources, mathematical models were developed. A system of differential equations describes the microscopic behavior of the various ions. Moreover, taking account of some other relations from MHD theory and of general laws, it is possible to deduce the ionic and electronic concentration distributions and other fundamental parameters such as cross sections, pressures .... On the other hand, from these results and using a Monte Carlo method, as already described in a preceding conference, the density of ion formation of each charge state was determined for various magnetic field configurations. Depending on the status of the experimental program, results will be given concerning the use of inhomogeneous magnetic fields and possibly spectroscopic study of the ion source plasma. (auth)

11143 (CONF-720948-, pp 640-646) SUCCESSIVE IONIZATION DURING TIME OF FLIGHT. Becker, R. 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The maximum charge state in the ion currents from electron beam ion sources and discharge sources can be explained in a unified view by comparing the time of flight of ions through the ionization volume with the time necessary for successive ionization by electron impact. For electron beam sources it is pointed out the importance of current density for producing high currents in high charge states. Then a time-of-flight operation of an electron beam ion source may yield higher charge states at higher ion currents compared to discharge sources, even in DC-operation. (auth)

11144 (CONF-720948-, pp 647-753) SPECTROSCOPIC INVESTIGATION OF THE PLASMA NEAR AN ANODE SPOT OF A PULSED VACUUM ARC ION SOURCE. Bacon, F. M. (Sandia Labs., Albuquerque, NM). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A spectroscopic investigation was made of the plasma near an anode spot of a pulsed vacuum arc was made in an attempt to determine the electron temperature from the ratio of Al III spectral intensities. (JFP)

11145 (CONF-720948-, pp 654-660) ANEL-TYPE ION SOURCES. Boscolo, I. (Univ., Lecce, Italy); Coisson, R.; Leo, M.; Luches, A.; Brautti, G.; Raino, A. 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Works are in progress about two mode-machines—ANEL 1 and ANEL 2—where multiply-charged ions can be produced. Atoms are ionized by electron bombardment and accelerated by the electric field produced by an electron ring which drifts perpendicularly to the external magnetic field. Along the path, ions trapped into the ring volume are exposed to the current of electrons and the electronic bombardment produces an increasing ionization. Descriptions of the two machines are given, together with the status of works and the first results of ANEL 1. (auth)

11146 (CONF-720948-, pp 668-674) EXPERIMENTAL AND THEORETICAL STUDY OF THE TRANSMISSION RATE OF A NIER ION SOURCE WITHOUT AUXILIARY MAGNETIC FIELD. Chantreau, J. (Laboratoire d'Electronique et de Sepctrometrie de Masse, Poitiers, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The purpose was to determine the transmission rate of ions from that NIER source whose repeller voltage was equal to zero ($V_R = 0$), for various accelerating voltages (V_p), of ions, at first by experiment, then theoretically. (auth)

11147 (CONF-720948-, pp 675-681) ION SOURCE FOR LOW ENERGY ION-NEUTRAL SCATTERING EXPERIMENT. Arikawa, T.; Mochizuki, T.; Hirakawa, H.; Miyamoto, G. (Tokyo Univ.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A low energy ion beam source for studying the chemical kinetics of single collision events between low energy ions and molecular beams was developed. Using the present ion beam source, elastic differential scattering experiments were carried out. (auth)

11148 (CONF-720948-, pp 709-715) ION SOURCES WITH A LOW ELECTRON ENERGY SPREAD. Stamatovic, A. (Inst. of Physics, Belgrade). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The source described was designed in order to study some of the electron collision processes with atoms and molecules. The onset part of the ionization curve for argon is shown for the energy range 12 to 17 eV. (JFP).

11149 (CONF-720948-, pp 716-723) ION SOURCE OBTAINED BY IMPACT OF A HIGH ENERGY MOLECULAR BEAM. Devienne, F. M.; Roustan, J. C. (Laboratoire de Physique Moleculaire des Hautes Energies, Peymeinade, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

A low energy ion source constructed having a low kinetic energy dispersion and allowing the production of organic ion beams. This source is very steady, has the advantage of producing organic ions without decomposition, allows operation with positive or negative ions. It is possible to operate with all pure gases and mixtures and with all kinds of solids or liquids having a low pressure. The dispersion is low and can be improved to obtain a very low dispersion. (JFP)

11150 (CONF-720948-, pp 784-789) CHARACTERISTICS OF A NEWLY DESIGNED ELECTRON BOMBARDMENT TYPE SIMPLIFIED ION SOURCE FOR HIGH TEMPERATURE OPERATION. Takagi, T.; Yamada, I.; Ishikawa, J.; Fuyuki, Y. (Kyoto Univ.). 1972.

From 2nd international conference on ion sources; Vienna Austria (11 Sep 1972).

Plasma characteristics of an electron-bombardment type simplified ion source for high temperature operation are studied. Potential distributions, particle flows in the plasma chamber and in the extraction region in a computer experiment, and advanced data on plasma density under various operating conditions are reported. (JFP)

11151 (CONF-720948-, pp 797-803) "TRIPLASMATRON": NEGATIVE AND POSITIVE ION SOURCE. Aubert, J.; Gautherin, G.; Lejeune, C. (Univ. Paris, Orsay, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The energy of the electron flux is controlled to adjust it to the maximal cross section of the ions studied. The expansion cup is polarized relative to the anode of the duoplasmatron. A positive polarization is the most interesting case: a third plasma forms in the expansion cup hence the name of triplasmatron which is given to this new source. The collection characteristics of the electron current which is collected on the cup and ion current as a function of polarization between the cup and the duoplasmatron anode show a discontinuity for a critical value of the polarization. A low pressure discharge forms. The ion density increases and therefore the intensity of the ion beam. The grain can reach a factor of 10. (JFP)

11152 (CONF-720948-, pp 812-824) TWIN ANODE ION SOURCE. Franks, J. (Ion Tech Ltd. Prince of Wales Industrial Estate, Abercarn, Eng.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The ion source consists of two anode rods inside a cathode cylinder. The resulting field induces electrons to follow long oscillatory paths before capture by an anode. The tube can therefore operate at low pressure as a cold cathode ion source without recourse to a magnetic field. Positive ions attracted to the cathode emerge through an aperture as an intense directed beam. Extraction therefore presents no problems. The dimensions of the source and aperture can be widely varied, accordingly ions may emerge as a fine pencil or cover a large area. Source parameters and various applications are discussed. (auth)

11153 (CONF-720948-, pp 856-862) ALKALI DIFFUSION SOURCE FOR LOW ENERGY IONS. Boeddicker, W. (Physikalisch-Technische Bundesanstalt, Brunswick). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

An alkali diffusion ion source for the production of low energy small divergence ion beams was developed. (auth)

11154 (CONF-720948-, pp 863-869) COMPARISON OF THE PROPERTIES OF AN ION SOURCE WITH OSCILLATING OR NON-OSCILLATING ELECTRONS. Wittmaack, K.; Schulz, F. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

In the study of beam formation in a telefocus ion gun it was found that parameters such as source pressure and geometry of the ion source opening have a strong influence on the shape of the beam profile. The source characteristics are investigated under the condition of beam focusing at target position. Both modes of operation are studied especially their pressure dependence. The source pressure dependence of the beam and emission currents are found. (JFP)

11155 (CONF-720948-, pp 870-875) APPLICATION OF CATHODE SPUTTERING METHOD TO ION SOURCES OF ELECTROMAGNETIC MASS SEPARATORS. Zuk, W.; Maczka, D.; Meldizon, J.; Pomorski, J.; Kisielewicz, M. (Marie Curie-Sklodowska Univ., Lublin, Poland). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The operation and performance of a cathode sputtering ion source for ion implantation in semiconductors are discussed. Ar^+ or Xe^+ ions were used to bombard the sample. Graphs of ion currents vs. sputtering voltage are given for platinum, tantalum, molybdenum, and iron. (WHK)

11156 (CONF-720948-, pp 884-888) ADIABATIC AND NON-ADIABATIC MODELS FOR A REFLEX H^- ION SOURCE. Cohen, J.; Sermet, P.; Stingre, D. (Univ., Grenoble, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Baribaud, Dolique, Sautter have developed an isothermal model for a reflex discharge. Owing to the essential influence of the electronic temperature on the inelastic processes which give rise to the H^- ions or destruct them, a search was made for more general nonisothermal models. (auth)

11157 (CONF-720948-, pp 889-894) EXPERIMENTAL STUDY OF A COMPOSITE ANODE. Reflex Source. Baribaud, M.; Cohen, J.; Sermet, P.; Stingre, D. (Univ., Grenoble, France). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

In order to use the theoretical model of a reflex source the experimental order of magnitude of the longitudinal ionic and electronic losses is required. For this purpose an experiment with a composite model is undertaken with a composite model whose elements are isolated. A symmetric anode, a dissymmetric one, and an anode whose front is isolated with respect to the source were constructed. It was shown that this reflex discharge source is dissymmetric. There are two opposite strong longitudinal currents, ionic towards the anticathode and electronic towards the anode neck. There is weak radial ambipolar diffusion. (JFP)

11158 (KFK-1871) CONSTRUCTION AND TESTING OF TWO PIERCE-TYPE ELECTRON GUNS. Karow, H. U. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Sep 1973. 14p. (In German). Dep. NTIS (U.S. Sales Only) $3.00.

The construction of two Pierce-type electron guns including the electric power supply and control are described. The operation parameters are reported of the electron guns operating in high-temperature experiments under UHV-conditions. Also, the numeric fundamentals necessary for the quantitative design of Pierce electron guns are presented. (auth)

11159 THEORETICAL ANALYSIS OF THE ENERGY SPECTRA OF BACKSCATTERED IONS. Brice, D. K. (Sandia Labs., Albuquerque, NM). Thin Solid Films; 19: No. 1, 121-135(5 Dec 1973).

An equation is derived which governs the energy spectrum of ions backscattered from a target whose composition varies continuously with depth. The equation also includes the effects of path length straggling on the energy spectrum through integrations over the depth distributions of both the incident and the back-scattered ions. When path length straggling is negligible, the equation reduces to a simple form, not involving integrations. The general equation is used together with model ion depth distribution functions to investigate the effects of the shape of the ion distribution on the predicted back-scattered spectrum. Delta functions, gaussian and several skewed distributions are used for this investigation. The predicted back-scattering spectra from these different distributions show little difference except at the energies corresponding to the back

edge of a thick film target. At these energies the gaussian distribution provides some spreading of the observed edge, and skewing produces additional broadening and some tailing. For realistic skewing of the ion distributions the predicted tailing is not sufficient to account for the low energy tails observed in many experiments. These results suggest that accurate spatial ion distributions will be required before detailed analysis can be carried out on the sharp features of thick target spectra. The simplified form of the general equation is used together with an iterative procedure to obtain the depth distribution of target composition from a complex experimental spectrum. (auth)

11160 DEPENDENCE OF ANGULAR DISTRIBUTION OF ELECTRONS INELASTICALLY SCATTERED BY METALS UPON THEIR ENERGY. Vorotneva, L. V.; Eliseenko, L. G. (Far East State Univ., Vladivostok, USSR). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 11, 2751-2753(May 1973).

Translated from Fiz. Tverd. Tela; 14: No. 11, 3230-3232(Nov 1972).

The angular distributions of electrons inelastically scattered from an Al surface are measured in the following ranges of energies of the scattered electrons: $kE_p < E < E_p$, where the primary energy $E_p = 2.6$ keV and $k = 0.2$, 0.5, and 0.95. The experimental distributions are compared with various theoretical predictions. Complete agreement obtains only if the theory allows for multiple collisions. (auth)

11161 MECHANISM OF SURFACE MICRO-ROUGHENING BY ION BOMBARDMENT. Sigmund, P. (Univ. of Copenhagen). J. Mater. Sci.; 8: No. 11, 1545-1553(Nov 1973).

The spatial distribution of sputter-etch effects is analyzed theoretically under the assumption of random slowing-down of the bombarding ions. When a surface is bombarded at locally oblique incidence the most pronounced sputtering effect is likely to be observed not at the very point of impact, but further "downstream". This effect may cause a significant reduction of the local sputtering yield on top of a spike or a ridge, and an increase on the bottom of a groove or a crater. As a consequence, small irregularities on a relatively smooth surface may be enhanced during bombardment. It is concluded that a microscopically flat surface is unstable under high dose ion bombardment unless atom migration acts as a dominating smoothing effect. Conversely, sharp cones appear to be suprisingly stable under bombardment. Even on a clean surface, cones erode more slowly than a plane surface, provided that their dimensions are of the order of, or less than, the penetration depth of the ions. (auth)

Atomic and Molecular Properties

Refer also to abstracts 11178, 11179, 11181, and 12439.

11162 (JINR-P2-7530) PROTON STRUCTURE AND THE FINE SPLITTING IN THE HYDROGEN ATOM. Nyunko, N. E.; Tyukhtyaev, Yu. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

With the help of the quasipotential method the influence of the proton structure on the fine splitting of the energy levels of a hydrogenic atom is investigated in the two-photon exchange approximation. (auth)

11163 NON PERTURBATIVE APPROACH TO HYPERFINE SPLITTING. Edwards, D. Jr. (National Research Council of Canada, Ottawa). Phys. Lett.; 45A: No. 5, 385-386(22 Oct 1973).

A hyperfine energy splitting for atomic hydrogen is calculated in a nonperturbative manner for a finite width contact interaction. A close agreement between this result and first order perturbation theory is obtained. (auth)

11164 PROGRAM TO EVALUATE THE REDUCED MATRIX ELEMENTS OF SUMMATIONS OF ONE-PARTICLE TENSOR OPERATORS. Robb, W. D. (Univ. of Colorado, Boulder). Comput. Phys. Commun.; 6: No. 3, 132-148(Sep 1973).

The program REDUCED TENSOR MATRIX ELEMENTS written in FORTRAN for the ICL 1907, CDC 6600, and IBM 360/75 is described for the evaluation of matrix elements of summations of one-particle tensor operators for the calculation of nuclear and atomic properties. This program permits one to calculate such matrix elements of any spin-dependent or spin-independent one-particle tensor operator between arbitrarily coupled L–S configurations. (JFP)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

11165 (COO-3373-10) DETECTION OF PHASE TRANSITIONS IN MOLECULAR CRYSTALS AND MACROMOLECULAR SUBSTANCES BY POSITRON ANNIHILATION. Chuang, S. Y.; Tao, S. J. (New England Inst., Inc., Ridgefield, Conn. (USA)). Jan 1974. Contract AT(11-1)-3373. 18p. (CONF-730561-2). Dep. NTIS $3.00.

From meeting on applications of phase transitions in materials science; University Park, Pennsylvania, USA (23 May 1973).

Positron lifetimes in three molecular crystals, methanol, deuterized methanol and methyl mercaptan, measured as a function of temperature from –150 to –80°C are studied. The long lifetime τ_2 and the relative intensity I_2 of o-Ps show a marked discontinuity at the solid-solid phase transition as well as at the solid-liquid phase transition in these molecular crystals. Positron lifetimes in n-tetradecane, n-hexadecane, n-octadecane, and polyethyleneglycols of various molecular weights from 200 to 1450 were also investigated as a function of temperature from –78 to 100°C. Temperature and phase dependence of Ps lifetimes in these macromolecular substances is discussed. (auth)

11166 (JINR-P12-7423) ROLE OF TRANSFER OF PIONS IN SUPPRESSION OF π^- MESON CAPTURE BY BOUND HYDROGEN. Petrukhin, V. I.; Risin, V. E.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

In the experiments with mixtures containing hydrogeneous molecules there was observed the transfer of π^- mesons from $p\pi^-$ mesic atoms, produced by bound hydrogen, to heavy atoms using the slow π^- meson beam of the JINR synchrocyclotron. The peculiarities of this process as compared to the transfer of pions in H_2 + Z mixtures are discussed. (auth)

11167 M1 AND E2 HYPERFINE EFFECTS IN MUONIC ^{93}Nb. Povel, H. P. (Univ., Karlsruhe, Ger.). Nucl. Phys.; A217: No. 3, 573-588(1973).

The hyperfine structure of the 2p-1s, 2s-2p, and 3d-2p transitions in muonic $^{93}_{41}$Nb was measured. The M1 hyperfine splitting of the $1s_{\frac{1}{2}}$, $2s_{\frac{1}{2}}$, and $2p_{\frac{1}{2}}$ levels is $\Delta(1s_{\frac{1}{2}}) = 3.51 \pm 0.11$ keV, $\Delta(2s_{\frac{1}{2}}) = 0.51 \pm 0.05$ keV, and $\Delta(2p_{\frac{1}{2}}) = 0.86 \pm 0.05$ keV in agreement with the pairing plus quadrupole model. The E2 hyperfine coupling constant of the $2p_{\frac{3}{2}}$ level is $A_2(2p_{\frac{3}{2}}) = -0.68 \pm 0.03$ keV. From this the spectroscopic quadrupole moment of the $^{93}_{41}$Nb $\frac{9}{2}^+$ ground state was derived as $Q = -0.32 \pm 0.02$ b, corresponding to an effective charge $e_{eff} = 1.79 \pm 0.14$ for the $g_{\frac{9}{2}}$ proton. (auth)

Collision Phenomena

Refer also to abstracts 11111, 11112, 11114, 11147, 11307, and 11722.

11168 (CONF-720948-, pp 24-30) PREDICTION OF THE FRAGMENTS OF TETRAMETHYLEKALEAD FORMED BY ELECTRON IMPACT. Heumann, K. G.; Baechmann, K.; Kubassek, E.; Lieser, K. H. (Technische Hochschule, Darmstadt, Ger.). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The tetramethyl compounds of Si, Ge, Sn, and Pb were investigated mass spectrometrically using equal conditions. The absolute intensities as a function of electron impact energy, the extrapolated relative intensities of the fragments, and ion yields of fragments as a function of atomic number are found. This study is useful for determining the behavior of tetramethylekalead in an ion source. (JFP)

11169 (CONF-720948-, pp 31-54) CHARGE CHANGING COLLISIONS: A REVIEW OF RECENT PROGRESS. Gilbody, H. B. (Queen's Univ., Belfast). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Some aspects of the various types of charge changing collisions, an understanding of which is desirable for the efficient design and operation of many types of ion sources and ion beam systems are reviewed. (JFP)

11170 (CONF-720948-, pp 62-68) IONIZATION OF A GAS TARGET BY CHARGE EXCHANGE OF INTENSIVE PROTON BEAM AND THE YIELD OF EXCITED ATOMS. Panassenkov, A. A.; Semashko, N. N. (Inst. of Atomic Energy, Moscow). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

Since the existence of a plasma in the target could lead to reduction of the yield of highly excited hydrogen atoms because of their ionization in collisions with ions and atoms, the degree of magnesium target ionization was determined by measuring the target plasma parameters. The relative ionization of magnesium target as a function of 20-keV proton beam energy, the current ratio of ions produced by ionizing field to total neutrals

as a function of $\sqrt{E}$, and the yield of excited atoms per incident ion x n^3 as a function of target thickness at 15 to 25 keV were determined. (JFP)

11171 (CONF-720948-, pp 85-91) NEW METHOD FOR THE MEASUREMENT OF RATE COEFFICIENTS BY MEANS OF A STATIONARY HOLLOW-CATHODE GLOW DISCHARGE. Lindinger, W. (Univ., Innsbruck). 1972.

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The described method permits reaction rate constants to be determined from the radial ion density profiles in the NG of a hollow-cathode discharge. This method may be applied not only for examining ion-molecule reactions, but, among other things, also for studying ion production by electron impact and volume recombination. (auth)

11172 (HMI-B-143) THEORY OF SEMICLASSICAL APPROXIMATION AND ITS APPLICATION IN HEAVY ION COLLISIONS. Gross, D. H. E. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany)). Oct 1973. 65p. Dep. NTIS (U.S. Sales Only) $5.25.

The discussion covers classical Rutherford scattering, a semiclassical description of elastic scattering due to Ford and Wheeler, the semiclassical approximation in general and its relation to the correspondence principle, applications of the theory, and deep inelastic heavy ion reactions and nuclear friction. (JFP)

11173 (N-73-29733) CALCULATED DIPOLE MOMENT AND ENERGY IN COLLISION OF A HYDROGEN MOLECULE AND A HYDROGEN ATOM. Patch, R. W. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 38p. (NASA-TM-X-2839; E-7342). NTIS $3.00.

Calculations were carried out using three Slater-type 1s orbitals in the orthogonalized valence bond theory of McWeeny. Each orbital exponent was optimized, the H2 internuclear distance was varied from 7.416 × 10 to the –11th power to 7.673 × 10 to the –11th power m (1.401 to 1.450 bohrs). The intermolecular distance was varied from 1 to 4 bohrs (0.5292 to 2.117 × 10 to the 10th power). Linear, scalene, and isosceles configurations were used. A weighted average of the interaction energies was taken for each intermolecular distance. Although energies are tabulated, the principal purpose was to calculate the electric dipole moment and its derivative with respect to H2 internuclear distance. (auth)

11174 (ORNL-4903, pp 72-82) ATOMIC AND MOLECULAR RADIATION PHYSICS. Christophorou, L. G.; Anderson, V. E.; Blaunstein, R. P. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Research on the collisions of electrons with molecules is summarized. (JFP)

11175 (ORNL-4903, pp 93-102) ELECTRON AND ION COLLISION PHYSICS. Compton, R. N.; Anderson, V. E.; Carter, A. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Research on electron–molecule and ion–molecule collisions is summarized. (JFP)

11176 HIGH-RESOLUTION Ne AUGER SPECTRUM PRODUCED IN 4.2-MeV H^+–Ne COLLISIONS. Stolterfoht, N.; Gabler, H.; Leithaeuser, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Lett., 45A: No. 5, 351-352(22 Oct 1973).

Auger electrons resulting from 4.2-MeV proton impact on Ne were measured by 1.2 eV spectroscopic resolution. The proton-induced Auger spectrum was found to be identical to the spectra previously observed by electron and photon bombardment. (auth)

11177 COEFFICIENTS OF FRACTIONAL PARENTAGE FOR IONIZATION OF PARTLY FILLED f SHELLS COMPARED WITH PHOTOELECTRON SPECTRA OF LANTHANIDE COMPOUNDS AND METALS. Cox, P. A. (Oxford Univ.); Baer, Y.; Jorgensen, C. K. Chem. Phys. Lett.; 22: No. 3, 433-438(15 Oct 1973).

In Russell–Saunders coupling, the removal of one f electron obeys symmetry-determined selection rules, but the probability of forming the many allowed states is highly varying and explains the detailed structure of the x-ray induced photoelectron spectra. (auth)

11178 DOUBLY EXCITED STATES OF HELIUM INDUCED BY LOW-ENERGY ELECTRON IMPACT. Knoop, F. W. E. (Leiden Univ.); Kistemaker, J. Phys. Lett.; 46A: No. 1, 27-28(19 Nov 1973).

The double retarding potential difference method allows the detection of doubly excited states by measuring the electrons resulting from the decay of these states into ions. This is illustrated in the case of helium. (auth)

11179 DETERMINATION OF THE ABSOLUTE DIFFERENTIAL CROSS SECTIONS FOR THE $1^1S \rightarrow 4^1S$, 4^1D, 5^1S, AND 5^1D TRANSITIONS IN HELIUM ATOMS. Pochat, A.; Rozuel, D.; Peresse, J. (Univ., Brest, France). J. Phys. (Paris); 34: No. 8, 701-709(Aug 1973). (In French).

The electron–proton coincidence method was used to determine the absolute differential cross sections for electron–atom scattering in helium. These studies were made for excitation of the 4^1S, 4^1D, 5^1S and 5^1D states which are not resolved by an electron spectrometer; the experiments were performed for incident energies from 50 to 200 eV and for angles of 5 to 20 deg. The generalized oscillator strengths of the transitions studied were obtained from the values of the differential cross sections. (auth)

11180 STRONG-COUPLING SEMICLASSICAL METHODS. The Average Approximation for Atom–Atom Collisions. Riley, M. E. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 8: No. 2, 742-753(Aug 1973).

Calculations on the $2p\sigma_u - 2p\pi_u$ excitation in proton-hydrogen collisions demonstrate that strongly coupled radial equations may be solved using simple semiclassical approximations at the turning points. A theoretical justification of the best of these methods is based on an extension of the large-mass high-energy approximation into the turning-point region. Other model problems are solved to illustrate properties of this new average approximation. (auth)

11181 REISS APPROXIMATION AT MODERATE INTENSITIES. Haque, S. N. (Univ. of Delhi). Phys. Rev., A; 8: No. 2, 697-799(Aug 1973).

It is shown that for an intensity parameter much less than unity, the Reiss approximation for the multiphoton ionization of atoms is equivalent to the neglect of the mean-frequency term in the treatment of Bebb and Gold. Also the result of Reiss is improved upon by including a first-order term. As an example of the above result, numerical values for many-photon 1s → 2s transitions in hydrogen atoms are presented and are compared with the exact values of Gontier and Trahin. (auth)

11182 ANOMALOUS TARGET Z DEPENDENCE OF DOUBLE TO SINGLE K-SHELL VACANCY PRODUCTION IN Cl-BEAM X RAYS. Woods, C. W.; Hopkins, F.; Kauffman, R. L.; Elliott, D. O.; Jamison, K. A.; Richard, P. (Kansas State Univ., Manhattan). Phys. Rev. Lett.; 31: No. 1, 1-3(2 Jul 1973).

X rays from 30-MeV Cl beams on various solid targets between carbon and copper were measured. The ratio of double K-shell to single K-shell vacancy production in Cl exhibits a broad peak near Z = 20 (Ca). This behavior is not predicted by Coulomb ionization. This peaking is examined using a molecular-orbital mechanism. To explain the results both K-shell electrons must be promoted to the vacant orbitals of the Cl beam. This is the first evidence of double K-shell promotion. (auth)

11183 DIFFRACTION AND RAINBOW IN ATOM-SURFACE SCATTERING. Boato, G.; Cantini, P.; Garibaldi, U.; Levi, A. C.; Mattera, L.; Spadacini, R.; Tommei, G. E. (Univ., Genoa). J. Phys., C (London); 6: No. 21, L394-L398(30 Oct 1973).

The diffractive scattering of nearly monochromatic helium and neon beams from a (001) cleaved LiF surface at low temperatures was experimentally studied. A quantum theory of surface rainbow based on a corrugated hard surface model was developed. The calculated relative intensities of diffraction peaks agree with the measured values. (auth)

11184 BUB's MISUNDERSTANDING OF BELL'S LOCALITY ARGUMENT. Freedman, S.; Wigner, E. (Princeton Univ., NJ). Found. Phys.; 3: No. 4, 457-458(Dec 1973).

Bub's criticism of Bell's locality postulate is discussed. The locality postulate is explained, and it is shown that Bub is in fact arguing against a class of theories which are subject to stronger restrictions than this postulate, and therefore his "refutation" of the latter is misleading. (auth)

11185 CALCULATION OF DOUBLE DIFFERENTIAL CROSS SECTIONS FOR IONIZING COLLISIONS OF ELECTRONS WITH HELIUM BY BORN APPROXIMATION AND BINARY ENCOUNTER THEORY. Tahira, S. (Kyoto Univ.); Oda, N. J. Phys. Soc. Jap.; 35: No. 2, 582-591(Aug 1973).

The double differential cross sections (ddcs's) for secondary electrons resulting from ionizing collisions of electrons with helium atoms were calculated with three kinds of approximations; the scaled Born approximation, the plane-wave Born approximation, and the binary encounter theory. The energies of incident

electrons are 500 and 2000 eV, and the energies of secondary electrons are 5 ~ 200 eV. While the ddcs's calculated by the scaled Born approximation excellently well reproduce the experimental ddcs's for 2000 eV electron impact, the discrepancies between theory and experiment are rather remarkable in the low and intermediate energy regions of secondary electrons for 500 eV electron impact. The ddcs's in the intermediate angular range are well reproduced by the binary encounter theory, which also yields the forward rise experimentally observed in the angular distributions. The agreement between the experimental and the plane-wave Born cross sections is very poor in the energy regions of incident and secondary electrons of interest here. (auth)

11186 CROSSED BEAM STUDIES OF LOW ENERGY He^+ IONS BY He ATOMS. Arikawa, T. (Tokyo Univ.). Shitsuryo Bunseki; 21: No. 2, 171-177(Jun 1973).

Differential scattering of He^+ ions by He atoms on the energy range of 10 to 100 eV over the scattering angle from 2 to 20° was measured using the crossed beam apparatus. Prominent oscillatory structures in the differential cross section resulting from the interference between waves scattered from the lowest gerade $^2\Sigma^+$ and ungerade $^2\Sigma^+$ states of a pseudo-molecular ion He_2^+ were observed. The rainbow peak due to the elastic scattering of He^+ by He was observed superimposed upon these oscillatory structures due to the resonant electron capture. The relative differential cross sections were normalized to the absolute data of Lorentz and Aberth. (auth)

11187 HIGH RESOLUTION Ne-AUGER SPECTRUM PRODUCED IN 4.2 MeV H^+ – Ne COLLISIONS. Stolterfoht, N.; Gabler, H.; Leithaeuser, U. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Phys. Lett.; 45A: No. 5, 351-352(22 Oct 1973).

Auger electrons resulting from 4.2-MeV proton impact on Ne were measured by 1.2 eV spectroscopic resolution. The proton-induced Auger spectrum was found to be identical to the spectra previously observed by electron and photon bombardment. (auth)

11188 ADIABATIC LIMIT AND NONADIABATIC EFFECTS IN THE SECOND ORDER TRANSITION POTENTIAL. Semi-Empirical Analysis. Csanak, G.; Taylor, H. S. (Univ. of Southern California, Los Angeles). J. Phys., B (London); 6: No. 10, 2055-2071(Oct 1973).

The second order transition potential introduced in a previous paper (Csanak, Taylor & Tripathy, J. Phys. B. Atom. Molec. Phys.; 6: 2040-54 (1973)) is generalized and analyzed from the energy-dependency point of view. The adiabatic limit and the first nonadiabatic correction is given. The same potential is analyzed also in terms of multipole moments, and it is shown how wave function methods can be used to calculate it. In the adiabatic, dipole limit the long-range part of the transition polarization potential agrees with the one used in the polarized Born approximation (Truhlar Thesis (1970)), Rice et al. (Phys. Rev.; A5: 762-82 (1972)). The same limit gives a generalization of Temkin's (Phys. Rev.; 107: 1004-12 (1957)) polarized orbital method for inelastic scattering. (auth)

Atomic Theory

11189 CALCULATIONS OF THE HYPERFINE CONTACT INTERACTION FOR A SERIES OF ATOMIC STATES. Kaipov, D. K.; Sakibaev, R. S.; Safronova, U. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 42-46(1972). (In Russian).

Calculations for the first two orders according to 1/Z were performed for the energy of the hyperfine contact Fermi interaction based on the field form of excitation theory for the configurations: $1s^22s^22p^63s3p^{n_1}3p^{n_2}$ and $1s^22s^22p^63p^{n_1}3d^{n_2}$. A connection between single-particle Coulomb Green functions and integral sums was encountered in atomic calculations by the Feynman diagram method. The importance of correlation diagrams in conjunction with Hartree–Fock diagrams is explained. (tr-auth)

11190 DYNAMICAL THEORY OF AUGER EFFECT. Haymann, P. (Rouen Univ., Mont-Saint-Aignan, France). Vide; 28: No. 164, 56-57(Mar 1973). (In French).

In order to extract information from Auger peaks even in the case of the failing of the kinematical approach, an analysis of transient phenomena which accompany the Auger electron creation and propagation through the metal or across its surface was made. Fundamental principle was introduced in order to avoid the adiabatic approximation, and quantitative results are given in the case of surface plasmon-electron interaction. (auth)

11191 HARTREE–FOCK EXPECTATION VALUES. Synek, M. (Univ. of Texas, Austin); Novaro, O. Rev. Mex. Fis.; 22: No. 1-2, 215-220(1973).

A discussion of the accuracy of the expectation values of one-electron operators using Hartree–Fock versus exact eigenfunctions is given. Some results from the literature for atoms and also calculated values in simple model systems are analyzed showing that the overall trends usually assumed do exist, but that in many cases important exceptions for particular operators arise. Such exceptions are related to some well defined characteristics of Hartree–Fock functions in turn associated to the analytical behavior of the potentials involved and to general aspects such as the validity of the Virial Theorem and the co-existence of one- and two-electron terms in the hamiltonian. All these aspects combine to produce important amplifications or reductions in the errors of Hartree–Fock values for certain operators. (auth)

11192 PSEUDO ATOM: A DISTORTED IMAGE OF ATOMIC SYSTEMS. Novaro, O. (Univ. Nacional de Mexico, Mexico City); Pineda, J.; Berrondo, M. Rev. Mex. Fis.; 22: No. 1-2, 115-134 (1973).

The so-called pseudo-atom, a completely solvable many-body model system, is analyzed by studying the analytical properties of its exact, as well as some independent-particle effective Hamiltonians (as the Hartree, Hartree–Fock, HFA, etc.) and also the correlation potentials. The attractive and repulsive potential operators are plotted and compared with the corresponding potentials for atoms to show when and how calculations on the pseudo-atom model can provide relevant information for the atomic physicist. It is shown that important differences between physical systems and the model exist, permitting some apparently paradoxical results obtained before to be explained and a prediction for how a given approximation technique will fare when applied to the pseudo-atom. The general conclusion reached is that to make relevant predictions for atoms, starting from pseudo-atomic calculations, great care must be taken to assess how the peculiar characteristics of the model will deform the information. Then, one can confidently draw conclusions for atoms by reconstructing the deformed image given by the pseudo-atom. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 11672.

11193 FLUID FLOW GENERATED BY SWITCHING A MAGNETIC FIELD ON OR OFF. Sneyd, A. (Waikato Univ., Hamilton, New Zealand). J. Fluid Mech.; 61: No. 2, 209-217(6 Nov 1973).

A uniform magnetic field is switched on at time t = 0 outside a body of conducting fluid. It is assumed that the field strength increases in time in proportion to $1 - e^{-\alpha t}$, where α is a constant of the circuit generating the field. Under the assumption of small magnetic Reynolds mumber and small magnetic Prandtl number the equations governing the diffusion of the field into the fluid are derived and a simple expression is given for the initial vorticity distribution produced in the fluid. The situation in which an initially uniform field is switched off is also considered. It is shown that, for sufficiently symmetrically shaped bodies of fluid, the vorticity generated by the switching-on of the field is the same as that generated by the switching-off. The particular case of an infinitely long circular cylinder of conducting fluid is considered in detail and an explicit expression is derived for the vorticity distribution. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 10245, 11251–11255, and 11380.

11194 EVENTS IN PHOTOEMULSIONS INDICATING THE FORMATION OF SUPERHEAVY FIREBALLS. Tret'yakova, M. I. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1368-1372(Jul 1973). (In Russian).

New data based on the analysis of nuclear interactions at energies from 5×10^{12} to 10^{13} eV (first type 5 + 0 + 31n and second type 3 + 1 + 100p), indicating the formation of superheavy fireballs, were reported. The distribution of the longitudinal components of four momenta quadrates was determined. An evaluation of the mass of the fireball was made from the angular distribution. The distribution of the azimuthal angle of the secondary particles was determined. (JSR)

Electromagnetic

Refer also to abstracts 10819 and 10892.

11195 (BMFT-FBK-73-25, pp 91-101) PHOTOPRODUCTION EXPERIMENTS. Burfeindt, H.; Buschhorn, G.; Heide, P.; Mess, K. H.; Schmueser, P. Sep 1973. (In German).

In annual report, 1972.

11196 (BMFT-FBK-73-25, pp 106-107, 114, 117, 119-120) EP INTERACTIONS IN THE STREAMER CHAMBER AT 7.2 GeV. Dau, H.; Drews, G.; Greubel, D.; Knoblock, J.; Meincke, W.; Nagel, H.; Rabe, E.; Spitzer, H. Sep 1973. (In German).

In annual report, 1972.

11197 (BMFT-FBK-73-25, pp 122-125) EXPERIMENTS AT THE CERN STORAGE RING. $pp \rightarrow \gamma X$. Brandt, A.; Fluegge, G.; Niebergall, F.; Schubert, K. R.; Schumacher, P. E.; Wilmsen, W. Sep 1973. (In German).

In annual report, 1972.

11198 (COO-3525-1) FINAL TECHNICAL REPORT ON RESEARCH IN HIGH ENERGY PHYSICS. 1. Photoproduction of Pions. 2. Colliding e^+e^- Beam Physics. (Southeastern Massachusetts Univ., North Dartmouth (USA)). Nov 1972. Contract AT(11-1)-3525. 11p. Dep. NTIS $3.00.

Research on pion photoproduction and $e^+ + e^-$ interactions in colliding beams is summarized. (JFP)

11199 (DESY-73-43) INCLUSIVE PHOTOPRODUCTION OF π^0 MESONS AT 6 GeV. Berger, C.; Dick, G.; Erlewein, W.; Luebelsmeyer, K.; Paul, L.; Meyer-Wachsmuth, H.; Schultz von Dratzig, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Oct 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

An experiment at DESY has been performed to study the inclusive photoproduction of π^0 mesons. Photoproduced π^0s were detected in a hodoscope consisting of 14 lead glass Čerenkov counters. To obtain the cross sections at a photon energy of 6 GeV the photon difference method was used. Data are presented in terms of the Feynman variable $x = q|^*|/(\sqrt{s}/2)$ and the transverse momentum $q_\perp$. Four $q_\perp$ distributions were measured at x = 0.2, 0.4, 0.6 and 0.8. The results show that the π^0 rate at small values of $q_\perp$ is smaller than the $\pi^\pm$ rate. The data can be fitted smoothly by a form $A \cdot e^{-Bq_\perp^2}$ with a value of about 3.5 GeV^{-2} for the slope parameter B. (auth)

11200 (NP-19873, pp 76-79) NEGATIVE PION PHOTOPRODUCTION FROM NEUTRONS BY LINEARLY POLARIZED PHOTONS IN THE 1st RESONANCE REGION. Kondo, K. (Tokyo Univ.); Miyachi, T.; Ukai, K.; Yamamoto, A.; Gotow, K.; Yoshida, H.; Kurokawa, S.; Muramatsu, H.; Sasao, N.; Suzuki, S.; Kobayashi, M.; Iwata, S. 1973.

11201 (NP-19873, pp 79-81) SINGLE CHARGE-PION PHOTOPRODUCTION FROM CARBON ABOVE 300 MeV. Baba, K. (Hiroshima Univ.); Endo, I.; Fujii, H.; Ninomiya, S.; Sumi, Y.; Anami, S.; Kato, S.; Murakami, A. 1973.

11202 (RL-73-88, pp 201-224) LEPTON PHYSICS WITH POLARIZED TARGETS. Close, F. E. (Daresbury Nuclear Physics Lab., Eng.). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

In the measurements of the total photoabsorption cross sections at SLAC and their dependence on the photon's mass ("νW_2") an interesting behavior was noticed which suggested that the photon might be interacting with point-like "partons" within the nucleon. The polarized photoabsorption cross sections will be a new test of such ideas. The case of real photons and the spin dependence of the real photoabsorption cross sections are discussed first and then the case where the photon is virtual (polarized electroproduction) is examined. (UK)

11203 (RLO-2041-93) SPIN CORRELATION MEASUREMENTS IN PSEUDOSCALAR MESON PHOTOPRODUCTION. Goldstein, G. R.; Owens, J. F. III; Rutherfoord, J. P.; Moravcsik, M. J. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics; Oregon Univ., Eugene (USA). Inst. of Theoretical Science). 1973. 53p. Dep. NTIS $4.75.

Because polarized photon beams and polarized proton targets have improved considerably and the techniques for measuring recoil baryon polarizations are continually improving, it is becoming feasible to measure double and triple spin correlations in pseudoscalar meson photoproduction. Of the large number of such experiments possible, only a few will add significantly new information to that already obtained from the existing cross section and limited polarization measurements. Using a simple, general, and transparent method, it is shown that all such measurements fall into three classes: those which are equivalent to more simple measurements, those which are highly bounded by previous measurements, and those which yield truly new information. (auth)

11204 FLUCTUATION OF THE NUMBER OF PARTICLES AND THE TRANSITION EFFECTS IN ELECTRON–PHOTON BEAMS IN LEAD AT ENERGIES ABOVE 20 GeV. Azimov, S. A.; Daudov, Z. Kh.; Kochetkov, G. A.; Kratenko, Yu. P.; Levkovich, S. G. (Tashkent State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1354-1355(Jul 1973). (In Russian).

Experimental data were obtained on the fluctuation of the number of particles at depths of 1.5, 4, 11, 15, 19, and 23 rad. units in electromagnetic cascades at energies above 20 GeV for four experimental intervals. The transition curves of lead–brass were also determined for five brass layers placed at a depth of 9.9 rad. units. (tr-auth)

11205 EXTENSIVE AIR SHOWERS WITH COMPLEX STRUCTURE OF THE ELECTRON–PHOTON CORE. Stanev, T. (Inst. of Nuclear Research and Nuclear Energetics, Sofia). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1403-1406(Jul 1973). (In Russian).

Some of the characteristics of showers with unusual structure of the electron–photon component in the region of the core and comparison of these characteristics with those characteristics of showers for which the three-dimensional distribution functions of the electrons are invariable in the core region were studied. The results showed that multicore showers represent a substantial part of all showers. Some increase of the percent of multicore showers was observed with increase of the depth of the level of observation. The increase of the density of muons and, possibly, of the nuclear active high energy particles near the core of the extensive air shower indicated that the deviation from the usual three-dimensional distribution functions of the electron–photon component is connected with the inherent nature of the shower. (JSR)

11206 INTERFERENCE PHENOMENA IN TRANSITION RADIATION. Belyakov, E. S.; Lorikyan, M. P.; Markaryan, K. Zh.; Muradyan, M. M.; Shikhyarov, K. K. JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 209-211(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 356-359(20 Sep 1973).

The results of an investigation of transition radiation produced by 3.0-GeV electrons in the photon frequency range 5 to 100 are presented for a radiator consisting of 230 aluminum foils each of thickness a = 8 microns as a function of the distance between the foils, which ranged from 50 to 1000 microns. The differential spectrum of transition radiation from the radiator, and the dependence of the total number of photons per electron on the distance between foils in the range 5 to 20 keV are shown. It is concluded that the interference between the plates in the stack and distance $b < z_{vac}$ leads to suppression of the transition radiation. (JFP)

11207 PARTICLE-NUMBER SPECTRUM OF EXTENSIVE AIR SHOWERS AT SEA LEVEL. Khristiansen, G. B.; Kulikov, G. V.; Solov'ev, V. I. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 207-209(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 353-356(20 Sep 1973).

Experimental results are presented on the investigation of the spectra of extensive air showers with respect to the number of particles N in the interval 10^6 to 10^8. The data indicate that the particle-number spectrum experiences a change in the region $N > 10^7$. (auth)

11208 MEASUREMENT OF THE REACTION $\gamma d \to \pi^- pp$, AND DETERMINATION OF CROSS SECTIONS FOR THE REACTION $\gamma n \to \pi^- p$, AT PHOTON ENERGIES BETWEEN 0.2 AND 2.0 GeV. Aachen-Bonn-Hamburg-Munich Collaboration. Nucl. Phys.; B65: No. 1, 158-209(1973).

The reaction $\gamma d \to \pi^- pp$ was measured in a bubble chamber experiment at DESY with a bremsstrahlung beam of $E_\gamma^{max} = 5.5$ GeV. Total and differential cross sections are presented for the energy region from 0.2 to 2.0 GeV. The extraction of cross sections on the neutron is discussed in detail. The impulse approximation and the closure relation, with corrections for the exclusion principle and the Fermi motion effects, as well as the Chew-Low extrapolation technique are applied. Total cross sections and angular distributions for the reaction $\gamma n \to \pi^- p$, deduced by these methods, are presented in graphs and tables. The results are compared with other experiments and with various predictions. No positive evidence for an isotensor electromagnetic current is found. The results disagree with some of the measurements of radiative pion capture, if detailed balance is assumed to connect the two reactions. (auth)

Weak

Refer also to abstract 10896.

11209 (COO-3071-37) MEASUREMENTS OF NEUTRINO AND ANTINEUTRINO CROSS SECTIONS AT HIGH ENERGIES. Benvenuti, A.; Cline, D.; Ford, W. T. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 25 Oct 1973. 13p. Dep. NTIS $3.00.

The dependence of the neutrino total cross section σ_ν on neutrino energy was measured up to 160 GeV. The data are consistent with a linear dependence with slope $(0.58 \pm 0.25) \times 10^{-38}$ cm^2/GeV. The ratio of the antineutrino to the neutrino total cross section $\sigma_{\bar\nu}/\sigma_\nu$ was found to be approximately constant up to 70 GeV at a value which is consistent with the numerical value of $1/3$ expected for the scattering of neutrinos and antineutrinos by relativistic pointlike spin $1/2$ fermions. (auth)

Strong (Baryon-induced)

Refer also to abstracts 11363, 11375, and 11486.

11210 (BMFT-FBK-73-25, pp 104-105, 113-114, 117-118) pp INTERACTIONS AT 12 AND 24 GeV/c. Andrescu, I.; Biobel, V.; Brandt, A.; Fesefeldt, H.; Hellwig, B.; Schwarz, B. Sep 1973. (In German).

In annual report, 1972.

11211 (BUP-53) PARTICLE PRODUCTION AT THE ISR. Lillethun, E. (Bergen Univ. (Norway). Dept. of Physics). Jul 1973. 82p. Dep. NTIS (U. S. Sales Only) $6.25.

A brief description of the CERN ISR and the experimental setups is followed by a short explanation of the symbols, definitions and kinematics used. Some general remarks on the production of particles precede more detailed discussion of the production of $\pi^\pm$, $K^\pm$ and $p^\pm$ in the forward direction and in the large angle region. Production of particles with large transverse momentum is also discussed while the results of searches for heavy or unknown particles were negative. Since the latter is satisfactory for theoreticians it may be said to be positive. A byproduct of quark-searching was the recording of deuterons and anti-deuterons, and this is discussed. Measurements of correlations between particles has only barely started and comments are given here only on $\pi^\pm\pi^\pm$-correlations when both particles have $p_T > Z$ GeV/c and the angle between the particles is $60 \lesssim \Theta \lesssim 120°$, and correlations in inelastic events with $x \sim 1^{20,40}$. (JIW)

11212 (COO-3065-56) PRODUCTION OF γ, Λ^0, K_s^0, AND $\bar\Lambda^0$ IN pp COLLISIONS AT 102 GeV/c. Chapman, J. W.; Cooper, J.; Green, N.; Roe, B. P.; Seidl, A. A.; Vander Velde, J. C.; Bromberg, C. M.; Cohen, D.; Ferbel, T.; Slattery, P. (Michigan Univ., Ann Arbor (USA); Rochester Univ., N. Y. (USA)). 1973. 12p. (UR-457; UMBC-73-20). Dep. NTIS $3.00.

Cross sections for γ, K_s^0, Λ and $\bar\Lambda$ production at 102 GeV/c were measured, and $\sigma(\gamma) = 170 \pm 16$ mb., $\sigma(K_s^0) = 4.6 \pm 0.5$ mb., $\sigma(\Lambda) = 3.2 \pm 0.4$ mb., and $\sigma(\bar\Lambda) = 0.23 \pm 0.10$ mb were found. Both $\langle n_{\pi^0}\rangle$ and $\langle n_{K_s^0}\rangle$ appear to rise linearly with n_- while the ratio $\langle n_{K_s^0}\rangle/\langle n_{\pi^0}\rangle$ is approximately independent of n_-. The integrated invariant cross section as a function of x as well as $d\sigma/dy$ and $d\sigma/dp_T^2$ are presented and compared with other data. (auth)

11213 (COO-3065-58) CROSS SECTIONS AND CHARGED PARTICLE MULTIPLICITIES AT 102 AND 405 GeV. Bromberg, C.; Chaney, D.; Cohen, D.; Ferbel, T.; Slattery, P.; Underwood, D.; Chapman, J. W.; Cooper, J. W.; Green, N.; Roe, B. P.; Seidl, A. A.; Vander Velde, J. C. (Rochester Univ., N. Y. (USA); Michigan Univ., Ann Arbor (USA)). 1973. 11p. (UR-459). Dep. NTIS $3.00.

The total inelastic cross section (σ_{inel}) and charged-particle multiplicities obtained in pp collisions at 405 GeV were measured. The data are from a preliminary 12,000 picture exposure of the 30-inch ANL/NAL liquid-hydrogen bubble chamber. It was found that $\sigma_{inel} = 32.8 \pm 1.0$ mb; the low moments of the multiplicity distribution for negative particles are: $\langle n_-\rangle = 3.50 \pm 0.07$, $D_- = 2.37 \pm 0.05$, $f_2^- = 2.1 \pm 0.2$, $f_3^- = 0.1 \pm 0.9$. Also updated results at 102 GeV are predicted.

11214 (COO-3065-61) PARTICLE MULTIPLICITIES AND CORRELATIONS AT NAL ENERGIES. Ferbel, T. (Rochester Univ., N. Y. (USA). Dept. of Physics and Astronomy). Oct 1973. Contract AT(11-1)-3065. 18p. (UR-462). Dep. NTIS $3.00.

A summary is presented of the latest data concerning particle multiplicities and correlations between particles produced in pp collisions at high energies. (auth)

11215 (DESY-73/36) MULTIPLICITIES, TOPOLOGICAL CROSS SECTIONS, AND SINGLE PARTICLE INCLUSIVE DISTRIBUTIONS FROM pp INTERACTION AT 12 AND 24 GeV/c. Bonn-Hamburg-Munich Collaboration. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Aug 1973. 64p. Dep. NTIS (U.S. Sales Only) $5.25.

Results on multiplicities, topological cross sections, total particle production cross sections, and correlations between charged particle and π^0 production are presented for pp interactions at 12 and 24 GeV/c incident laboratory momentum. Inclusive production of $\pi^\pm$, K_s^0, p, Λ, $\Sigma^\pm$ and $\bar\Lambda$ is studied; particle spectra are shown in single and double differential form and are compared, in different kinematic regions, with data obtained at other incident momenta and with other beam particles. (auth)

11216 (IS-T-617) ONE PION PRODUCTION IN $\bar pp$ INTERACTIONS AT 2.85 GeV/c. Hafen, E. S. (Ames Lab., Iowa (USA)). Dec 1973. 77p. Dep. NTIS $6.00

Thesis.

One pion production in $\bar pp$ interactions at 2.85 GeV/c was investigated using a total of 8526 events in three final states $p\bar p\pi^0$, $\bar pn\pi^+$, and $p\bar n\pi^-$. These states were found to be contaminated by spurious fits to these states of events from other final states in such a way that the amount of $\Delta(1236)$ resonance production appeared to violate the isospin and charge conjugation invariance of the strong interaction. The $p\bar n\pi^-$ state was most severely affected by the contamination. A χ^2 cut applied to all three final states removed most of the apparent isospin and charge conjugation invariance violations. The production and decay of the $\Delta(1236)$ resonance was then studied, avoiding in so far as possible any assumption about the production mechanism. A coherent sum of decay amplitudes reproduced the mass structure of the $\Delta(1236)$ better than an incoherent sum. The $p\bar p\pi^0$ state was found to be nearly 100% $\Delta^+(1236)$ or $\Delta^*(1236)$ production. The Δ^+ mass was measured as 1233 ± 4 (MeV/c^2) and the Δ^0 mass as 1220 ± 7 (MeV/c^2). Both the amount of $\Delta(1236)$ production and the Δ^+ and Δ^0 masses depend on the parameterization of the mass dependence of the decay amplitudes of the $\Delta(1236)$. Spin density matrix elements were inconsistent with one pion exchange. (auth)

11217 (LBL-2115) SINGLE PARTICLE INCLUSIVE SPECTRA RESULTING FROM THE COLLISION OF RELATIVISTIC PROTONS, DEUTERONS, AND ALPHA PARTICLES WITH NUCLEI. Jaros, J.; Papp, J.; Schroeder, L.; Staples, J.; Steiner, H.; Wagner, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 27p. (CONF-730943-10). Dep. NTIS $3.50.

From second international conference on elementary particles; Aix-en-Provence, France (6 Sep 1973).

The yields of positive and negative particles resulting from the collision of 1.05 GeV/nucleon and 2.1 GeV/nucleon protons, deuterons and alpha particles with targets of Be, C, Cu, and Pb. Single particle inclusive spectra were obtained at 2.5° (lab) for $\pi^\pm$, K^+, p, d, ^{3}H, ^{3}He, and ^{4}He. Discussion is limited to those aspects of these spectra which are related to possible applications and tests of various high energy interaction models. In particular, it is indicated how results bear on such concepts as limiting fragmentation, scaling, and the "parton" structure of the alpha particle and deuteron projectiles. (auth)

11218 (NP-19873, pp 105-113) STUDY OF THE ANGULAR CORRELATION IN MULTIPLE MESON PRODUCTION BY PROTON-NUCLEUS REACTIONS AT 22.6 GeV/c. (Yokohama National Univ.). 1973.

11219 (NP-19873, pp 113-118) OBSERVATION OF SUPER HIGH ENERGY INTERACTIONS BY EMULSION CHAMBERS WITH PRODUCING LAYERS. (Nagoya Univ.). 1973.

11220 (RL-73-88) PHYSICS WITH POLARIZED TARGETS AT HIGH ENERGY. A Cosener's House Informal Meeting Held on the 17th and 18th March 1973. Clark, A. G.; Worden, R. P. (eds.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 1973. 261p. (CONF-730346-).

Separate abstracts were prepared for the eleven papers presented. (UK)

For abstracts of individual papers see: 10864-10867, 11202, 11221-11224, 11235, and 11236.

11221 (RL-73-88, pp 1-66) POLARIZATION IN STRONG INTERACTIONS AT HIGH ENERGIES. Phillips, R. J. N.; Worden, R. P. (Rutherford High Energy Lab., Chilton, Eng.). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

A review and critical appraisal of experiments involving polarization in strong interactions at high energies are given. In gauging the value of experiments it is stated that one should consider: What amplitude information will it provide? Will it answer general questions, or decisively test specific models? For amplitude analysis, what supporting data are available? Are theoretical assumptions needed? Are they credible? Will the effect be large? What accuracy is needed for a significant result? These questions are applied to a range of 2-body and quasi-2-body reactions in the Regge region ($p_L > 3$ GeV/c). Some are seen to be particularly interesting and rewarding. Various general principles emerge, for evaluating possible experiments. The discussion is divided into sections headed; small amplitudes, a theoretical classification, specific reactions (vacuum exchange, natural parity meson exchange, mixed naturality meson exchange amplitudes, baryon exchange processes, inclusive polarization measurements), transversity amplitudes, theory-experiment mismatch, and energy dependence of amplitudes. (UK)

11222 (RL-73-88, pp 67-81) P AND R MEASUREMENTS IN π^-p SCATTERING AT 40 GeV/c. Merlo, J. P. (CEN de Saclay, Gif-sur-Yvette, France). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

The Serpukhov experiment on polarization measurement was installed in the experimental hall of the 70 GeV accelerator at the end of 1971. The accumulation of data started early in 1972. The experiment is being made in collaboration with the laboratories of Saclay (DphPE), Serpukhov (IHEP), Dubna (JINR) and Moscow (ITEP). The aim of the experiment is to measure simultaneously the polarization parameter P and the recoil proton spin rotation parameter R in π^-p scattering at 40 GeV/c. The main parts of the apparatus are described and shown diagrammatically. Experimental details for the measurement of P and R are given. Up to the time of writing $5.3.10^6$ events for the P experiment and $0.75.10^6$ events for the R experiment in π^-p at 40 GeV/c were registered. With part of the statistics the preliminary results for P up to 1 $(GeV/c)^2$ were obtained. (UK)

11223 (RL-73-88, pp 82-92) POLARIZED-PROTON TARGET EXPERIMENTS AT N. A. L. Yokosawa, A. (Argonne National Lab., IL). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

Technical aspects of some polarized-proton target experiments scheduled and considered at the Argonne National Laboratory are considered. The present status of the NAL accelerator is given and an experiment which involves forward polarization measurements in pp, πp and Kp elastic scattering is discussed. Three future experiments are considered at energies up to around 60 GeV/c. Comparison of polarization phenomena of all the elastic scattering processes: π^+p, K^+p, pp and $\bar{p}p$, πp charge-exchange and $\pi p \rightarrow \eta n$ reactions backward πp elastic scattering. (UK)

11224 (RL-73-88, pp 172-200) DEUTERATED TARGETS: THEIR PHYSICS INTEREST. Daum, C. (CERN, Geneva). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

A new field of experiments with polarized neutrons and polarized deuterons is now opening up. Some of these experiments were done with other techniques: with polarized protons on an unpolarized deuterium (neutron) target, and polarized deuterons (neutrons) on an unpolarized hydrogen target, where the beam polarization is obtained by scattering from a target, by analyzing the polarization of a final-state particle by its decay, or by a second scattering [e.g. $K^-n(p_s) \rightarrow \pi^-\Lambda(p_s)$, and $K^+n(p_s) \rightarrow \pi^-\Lambda(p_s)$, and $K^+n(p_s) \rightarrow K^0p(p_s)$]. Other experiments are equivalent to experiments with a polarized proton target (e.g. $\pi^+n\uparrow \rightarrow \pi^0p$ and $\pi^-p\uparrow \rightarrow \pi^0n$, etc.). A summary of these experiments is given. It is of interest to compare the analyzing power of these different techniques. These experiments have in common the problem of the Fermi momentum of the neutron in the deuteron, either as a projectile or as a target particle, except for double-scattering experiments with an incident neutron beam. Possible experiments in the field of hadron and lepton physics are discussed, with stress on hadron physics. (UK)

11225 ELEMENTARY ACTS OF THE INTERACTION OF HADRONS WITH ENERGY APPROX. 10^{13} eV. Apanasenko, A. V.; Guseva, V. V.; Dobrotin, N. A. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1358-1361(Jul 1973). (In Russian).

A description was given of the experimental installation at the Tyan-Shan'skoi mountain-top station designed for the study of the elementary acts of the interaction of particles of cosmic radiation with energy $\sim 10^{13}$ eV. The results of the preliminary analysis of the experimental material obtained are reported. (tr-auth)

11226 NUCLEON INTERACTIONS WITH NUCLEI OF CARBON, IRON, AND LEAD IN THE ENERGY RANGE FROM 600 TO 10,000 GeV. Azaryan, M. O.; Keropyan, M. I.; Mamidzhanan, E. A.; Martirosov, R. M.; Muradyan, M. M. (Erevan Physics Inst.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1356-1357 (Jul 1973). (In Russian).

The integral experimental spectra of single hadrons at mountain height were obtained on the large ionization calorimeter. The cross sections of the interactions of nucleons with the nuclei of C, air, Fe, and Pb were measured in the energy range up to 30,000 GeV. The dependence of the inelasticity coefficient of the neutrons on the atomic number of the substance was obtained. (tr-auth)

11227 FAMILIES OF γ QUANTA AND PROCESSES OF MULTIPLE GENERATION AT ENERGIES ABOVE 10^{13} eV. Nikol'skii, S. I.; Cherdyntseva, K. V. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1373-1376 (Jul 1973). (In Russian).

Acts of strong interaction were investigated by means of the analysis of families of γ quanta. The masses of the clusters formed, transmitted in the neutral component at ΣE_γ energy from 9 to 1000 TeV, were determined. Conclusions were drawn on the occurrence at $\Sigma E_\gamma \sim 40$ TeV of isobaric particles and of particles from following clusters which hinder the single-valued analysis of events. (tr-auth)

11228 PRELIMINARY RESULTS OF THE PAMIR-20-71 EXPERIMENTS ON THE INVESTIGATION OF INTERACTIONS AT ENERGIES OF APPROX. 10^{15} eV. Anishchenko, Yu. V. (Lebedev Inst. of Physics, Moscow); Baradzei, L. T.; Dobrotin, N. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1362-1367(Jul 1973). (In Russian).

The results obtained with the first chamber in the Pamir experimental program were reported. The effective energy threshold for the registration is 1.6 TeV for γ quanta and ~10 TeV for hadrons. The energy and angular distributions of the hadrons and γ quanta and the mean free absorption path of hadrons in air were obtained. Some individual cases of elementary interactions at energy $\sim 10^{15}$ eV were reported. (tr-auth)

11229 PROPERTIES OF HIGH ENERGY SECONDARY PARTICLES IN HADRON INTERACTIONS. Aganina, M. U.; Anoshin, A. I.; Bashindzhagyan, G. L.; Bel'zer, L. I.; Dem'yanov, A. I.; Murzin, V. S.; Sarycheva, L. I.; Sinev, N. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1380-1382 (Jul 1973). (In Russian).

The energy spectra of conserved nucleons in nucleon-nuclear interactions were studied in a wide energy range from 24 (accelerator data) to 300 GeV (cosmic radiation). (tr-auth)

11230 MEASUREMENT OF THE EFFECTIVE CROSS SECTION OF INELASTIC INTERACTIONS OF PROTONS WITH CARBON NUCLEI IN THE ENERGY RANGE FROM 10^{11} TO 10^{12} EV AT THE PROTON-4 COSMIC STATION. Akimov, V. V.; Veselova, G. V.; Grigorov, N. L.; Il'yushina, V. A.; Mamontova, N. A.; Nesterov, V. E.; Rapoport, I. D.; Savenko, I. A. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1383-1385 (Jul 1973). (In Russian).

On the artificial earth satellite Proton-4 measurements were made of the inelastic interaction cross section of protons with carbon in the energy range from 10^{11} to 10^{12} eV. For two values of the proton energy the following values of the cross section

were obtained: 242 ± 30 mb at 1.6×10^{11} eV and 287 ± 43 mb at 7×10^{11} eV. These results do not contradict data obtained in experiments on the artificial earth satellites Proton-1, 2, and 3. (tr-auth)

11231 PAIR CORRELATIONS IN THE INTERACTION OF COSMIC RAYS OF ENERGY APPROX. 400 GeV. Razdol'skaya, L. A.; Roinishvili, N. N. (Inst. of Physics, Tbilisi, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 206-207(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 350-352(20 Sep 1973).

Pair correlations between the rapidities of the secondary particles in interactions of cosmic rays with energy ~400 GeV is investigated. It is shown that if pionization is the main interaction mechanism, then the clearest ideas on the behavior of the correlation function can be obtained by investigating it in the rest system of the pionization particles. (auth)

11232 DEPENDENCE OF MULTIPLICITY ON RECOIL MOMENTUM IN p−p INTERACTIONS AT 28.5 GeV/c. Homma, Y.; Konishi, S.; Ochiai, F.; Okabe, H.; Teranaka, M. (Osaka City Univ.). J. Phys. Soc. Jap.; 35: No. 3, 937(Sep 1973).

The results of the analysis of a correlation between particles produced by p−p interaction at 28.5 GeV/c are presented. The recoil proton is chosen as the selected final particle and the relation of the mean multiplicity of charged particles to the variables of the recoil proton is studied. The results are found to be in agreement with the prediction based on short-range correlations. (LBS)

11233 DIFFERENCES OF TOTAL CROSS SECTIONS FOR MOMENTA UP TO 65 GeV/c. Denisov, S. P.; Donskov, S. V.; Gorin, Yu. P.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Inst. for High Energy Physics, Serpukhov, USSR). Nucl. Phys.; B65: No. 1, 1-28(1973).

Total cross sections for π^-, K^- and $\bar{p}$ on protons and deuterons were measured in the momentum range 15 to 60 GeV/c. Total cross sections for particle interactions with neutrons were determined with an energy dependent Glauber correction. Using the positive particle data obtained earlier with the same experimental apparatus, the differences of total cross sections for particles and antiparticles as well as for particles belonging to the same isospin multiplet were calculated. The differences of total cross sections for particles and antiparticles decrease with momentum following a power law. The differences between the pure isospin state cross sections are either close to zero or continue to decrease. The measured total cross sections and their differences are in agreement with relations predicted by quark and Regge-pole models. (auth)

Strong (Meson-induced)

11234 (BMFT-FBK-73-25, pp 107, 114-115, 117, 121) π^+p INTERACTIONS AT 11.7 GeV/c. Bassler, E.; Nagel, H.; Schlatter, W. D.; Wacker, K. Sep 1973. (In German).

In annual report, 1972.

11235 (RL-73-88, pp 93-124) R AND A EXPERIMENTS. Walker, T. G. (Rutherford High Energy Lab., Chilton, Eng.). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

Methods of measurement for the $\pi N \to \pi N$ system are discussed and means of extracting the amplitudes from the data considered. It is considered that limited measurements at high energies together with more systematic measurements at medium energies may be the most productive program in terms of phenomenological analysis. Various Regge pole models are reviewed which give plausible agreement with the existing data. An evaluation of these models can be made by the measurement of A and R parameters in hypercharge exchange reactions $\pi N \to K\Lambda/\Sigma$ and $\bar{K}N \to \Lambda\pi/\Sigma$. Experiments planned to investigate hypercharge exchange reactions are $\pi^-p \to K^0\Lambda^0$ at CERN, $\pi^-p \to K^0\Lambda^0$ at RHEL at moments up to 4.5 GeV/c, $\pi^+p \to K^+\Sigma^+$ at RHEL at momenta 3 to 5 GeV/c, and $\gamma^+p \to K^+ + \Lambda^0$, $K^+ + \Sigma^+$ at DNPL in the range $2.5 < E\gamma < 4.5$ GeV. (UK)

11236 (RL-73-88, pp 153-158) MEASUREMENT OF A AND R PARAMETERS FOR THE FORWARD AND BACKWARD PEAKS OF $\pi^-p \to K^0\Lambda^0$. Jones, W. G. (Imperial Coll., London). 1973.

From informal meeting on physics with polarized targets at high energy; Abingdon, Eng. (17 Mar 1973).

An "A and R experiment" was recently performed on the backward peak of $\pi^-p \to K^0\Lambda^0$ (fast forward Λ^0's) and another on the forward peak was proposed. Both experiments use the CERN-ETH Magnet Spark Chamber system (the so-called ω system) in 5 GeV/c beam lines at CERN and both have the same experimental approach which is to use a target polarized transverse to the beam direction and to use optical spark chambers in a magnetic field to achieve an approximately uniform coverage of all angles of the production plane and of the Λ decay. (UK)

11237 (TID-26497) RESONANCE STRUCTURE IN $K^-N \to Y\pi$ REACTIONS IN THE CENTER OF MASS ENERGY RANGE 1550 TO 1650 MeV. Morris, W. A. (Florida State Univ., Tallahassee (USA)). Jun 1973. 46p. Dep. NTIS $4.50.

Thesis.

The cross sections are determined for the reactions $K^-n \to \Sigma^-\pi^0$, $K^-n \to \Lambda^0\pi^-$, $K^-n \to \Lambda^0\pi^-\pi^0$, and $K^-n \to \Sigma^0\pi^-$ in the center of mass energy range 1550−1650 MeV. An energy-dependent partial wave analysis is made of the two-body final states, and evidence is presented for an I = 1, S = −1 baryon resonance at 1625 MeV with a full width of 45 MeV. A spin-parity assignment of $1/2^-$ is made for this resonance. (auth)

11238 (TID-26499) K^-d AND K^-np REACTIONS AT 727 MeV/c. Wieckowicz, R. P. (Florida State Univ., Tallahassee (USA)). Jun 1973. 120p. Dep. NTIS $8.00.

Thesis.

The differential cross sections for $K^-d \to K^-d$ and $K^-d \to K^-np$ scattering at an incident K^- momentum of 726.7 MeV/c were determined experimentally. These distributions were analyzed using the predictions based upon the Glauber model. Known K^-p amplitudes from hydrogen data along with variable K^-n amplitudes were used as input to the model. $K^-d \to K^-d$ data from experiments with beam momenta between 700 and 1200 MeV/c were also analyzed and compared with this experiment. The K^-n elastic differential cross section obtained from the spectator model was also measured and analyzed in terms of partial waves. It is found that the data can be represented using only background terms plus the known D_{13} $\Sigma(1660)$. (auth)

11239 MEASUREMENT OF THE POLARIZATION PARAMETER IN π^-p BACKWARD ELASTIC SCATTERING AT 6 GeV/c. CERN-Orsay-Oxford Collaboration. Nucl. Phys.; B64: No. 2, 45-57(1973).

The polarization parameter in π^-p elastic scattering was measured in the backward angular region at an incident momentum of 6 GeV/c. The measurements cover the range of four momentum transfer u = 0 to −1 $(GeV/c)^2$, and were obtained with a high intensity pion beam, a butanol polarized proton target, and arrays of scintillation counter hodoscopes. The polarization is different from zero, in contradiction to the prediction of the naive one trajectory Regge-exchange model. It increases positively with the four-momentum transfer u, reaching a maximum of about 0.4 at $u \approx -0.3$ $(GeV/c)^2$. It then decreases and becomes slightly negative beyond $u \approx -0.5$ $(GeV/c)^2$. A variety of baryon exchange models are briefly reviewed and none are found to be in complete agreement with all the experimental data. (auth)

11240 IDENTIFICATION OF HADRONS WITH ENERGY OF 500 GeV IN COSMIC RADIATION BY MEANS OF TRANSITION RADIATION. Avakyan, V. V.; Alikhanyan, A. I.; Bagdasaryan, L. S.; Vinnitskii, O. M.; Gavukchyan, S. M.; Kazaryan, S. S.; Kankanyan, S. A.; Mamidzhanyan, E. A.; Oganesyan, A. G.; Pleshko, M. P.; Tamanyan, A. G. (Erevan Inst. of Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1503-1505(Jul 1973). (In Russian).

By the Monte Carlo method the coefficient of rejection of pions and protons with momenta from 500 to 3000 GeV/c was calculated by use of a transition radiation recorder. Concrete experiments for the measurement of the spectra of individual cosmic pions and protons were proposed. (tr-auth)

11241 ASYMMETRY OF PION−NUCLEON INTERACTIONS. Lidenko, L. A.; Murzin, V. S.; Sarycheva, L. I.; Smirnova, L. N.; Shcheglova, L. M. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1377-1379(Jul 1973). (In Russian).

Attempts were made to determine the contribution of different processes to the total collision cross section of pions with protons at 16 and 40 GeV/c. (tr-auth)

11242 INELASTIC INTERACTION OF PIONS WITH THE NUCLEI OF EMULSIONS AT ENERGIES OF 60-GeV. Eliseev, S. M.; Kokhli, J. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1389-1391 (Jul 1973). (In Russian).

The characteristics of secondary particles generated during the interaction of pions at 60 GeV with C, N, O, Ag, and Br nuclei of emulsions were calculated by the Monte Carlo method using the intranuclear cascade model. The calculated results agree with experimental data. (tr-auth)

11243 REACTION $K^-p \to \Lambda\omega$ AT 3.13 AND 3.3 GeV/c. Cooper, A. M.; Lyons, L.; Clark, A. G. (Nuclear Physics Lab., Oxford). Nucl. Phys.; B65: No. 1, 210-241(1973).

New experimental data are presented on the reaction $K^-p \to A\omega$ from a bubble chamber experiment at 3.13 and 3.3 GeV/c. The cross section, production angular distribution, A-polarization, and ω-density matrix elements are determined. The joint decay distribution of the Λ and ω together is also investigated; this contains sufficient information to perform an almost complete amplitude analysis for the reaction. These amplitudes are used to test a duality + absorption hypothesis. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 11559, 11729, and 11730.

11244 (DESY-73-42) RELATIVISTIC THREE-PARTICLE PROBLEM AND HEAVY QUARKS. Meyer, R. F. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Oct 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

Strong binding of three scalar quarks is investigated in the framework of Bethe-Salpeter equations. After stating the relevant field-theoretic formulas, possible dynamical assumptions are discussed which can help to describe the observed baryon mass spectrum. Just as in the quark-antiquark case a covariant harmonic oscillator approximation may be formulated, and it is shown that this corresponds to linear Regge trajectories. The resulting Bethe-Salpeter amplitude of the ground state is used in a calculation of the electromagnetic radius by means of the triangle graph model. The oscillator constant as obtained by matching the Regge slope leads, independently of the quark mass, to 0.8 fm for the e.m. radius. (auth)

11245 (JINR-P2-7531) REFLECTING AND THE TWISTING OPERATORS IN THE MODEL WITH THE FINITE SET OF OSCILLATORS. Popov, Kh. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Using the expressions for the coherent states and for the multiperipheral chains with two Reggeons at the ends, build up with the help of a finite set of oscillators, the reflecting and twisting operators, that allow one in both cases to interchange the order of the external particles are obtained. (auth)

11246 GENERALIZATION OF THE MICHEL–WIGHTMAN FORMULA. Granovskii, Ya. I.; Kosmachev, O. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 73-75(1972). (In Russian).

The formal analog of the density matrix was obtained which, in a particular case, passes over into the formula of Michel and Wightman (1955). Using the expression developed, the transformation from invariant amplitudes to a spiral one for particles with random spins and masses leads to a well known technique for calculating a trace (Spur). (tr-auth)

11247 APPLICATION OF THE FIELD FORM OF THE THEORY OF EXCITATION FOR THE CALCULATION OF CONTACT HYPERFINE INTERACTIONS. Kaipov, D. K.; Sakibaev, R. S.; Safronova, U. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz. Mat.; No. 6, 13-21 (1972). (In Russian).

A theory of hyperfine Fermi interactions was constructed based on Green's field functions. Analytical expressions were obtained for the energy contribution of the first two orders according to the inter-electron interaction. An averaging of the ultimate expressions was performed on the basis of momentum theory. (tr-auth)

11248 BOOTSTRAP FROM THE PERSPECTIVE OF FORMAL LOGIC. Allen, A. D. (Algorithms, Inc., Northridge, CA). Found. Phys.; 3: No. 4, 473-475(Dec 1973).

The rules of formal logic favor the bootstrap over the fundamentalist interpretation of hadronic constituents. (auth)

11249 FACTORIZATION AND THE COUPLINGS OF THE VACUUM TRAJECTORY. Neff, T. L. (Univ. of California, Berkeley). Nucl. Phys.; B65: No. 1, 45-69(1973).

The decoupling theorems associated with an isolated factorizable pomeron pole of unit intercept are re-examined. It is found that the coupling of three such poles, $\Gamma(t,t,0)$, need not vanish, precisely at the point $t = 0$. This is demonstrated by summing only over states in the appropriate unitarity sum, and sum rule, which are consistent with the M^2, $s/M^2 \to \infty$ limit. The triple-Regge region then makes a constant contribution to σ_{total}, instead of the ln lns result obtained if the isolated pole is assumed to couple also to states such that s/M^2 = constant. The physical implications regarding factorization and the pole-cut relationship are discussed. The relationship between higher order optical theorems (Mueller discontinuities) and particular terms in the unitarity sum for the two → two-absorptive part A_{22} is exploited. Consistent contributions to the triple-Regge region contribute constant vertex corrections to pure pole behavior in A_{22}. There is no cut contribution and the magnitude of the vertex corrections reflects the relative amount of diffractive production. The analysis is extended to multiple fireball production where pure multipole structures emerge. The series naturally terminates if the diffractive component is sufficiently small. The implications for the behavior of the total cross section at machine energies are discussed. (auth)

11250 FIXED POLES AND COMPOSITENESS. Mueller–Kirsten, H. J. W.; Schwarz, F. (Universitaet Trier–Kaiserlautern, Ger.). Lett. Nuovo Cim.; 8: No. 14, 835-838(1 Dec 1973).

An attempt is made to clarify the relation between fixed and moving j-plane poles and the construction of the corresponding field operators connected with composite or elementary particles by reference to a particularly simple but representative example. (LBS)

11251 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 14, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 78p.

11252 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 16, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 90p.

11253 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 17, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 81p.

11254 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 18, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 84p.

11255 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 19, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 82p.

Electromagnetic

Refer also to abstract 10887.

11256 (COO-1764-192) RESONANCES IN HIGH-ENERGY COLLIDING LEPTON BEAMS. Rosner, J. L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 13 Mar 1973. Contract AT(11-1)-1764. 17p. (CONF-730334-10). Dep. NTIS $3.00.

From 8th Recontre de Moriond conference; Meribel-les-Allues, France (4 Mar 1973).

The search for the correct higher symmetry of decay vertices is discussed. It is noted that something higher than SU(3) is certainly valid and colliding lepton beams can help find what it is. $SU(6)_W$ and its limitations, L = 1, 2 mesons, and the two-photon processes $e^+ + e^- \to e^+ + e^-$ + hadrons, and $e^- + e^- \to e^- + e^-$ + hadrons are considered. (JFP)

11257 (COO-2271-19) INCLUSIVE ANNIHILATION PROCESSES IN PHI^4 FIELD THEORY. Mueller, A. H. (Columbia Univ., New York (USA). Dept. of Physics). 1973. 65p. Dep. NTIS $5.25.

The process $\phi(q) \to \phi(p)$ + anything, the process in ϕ^4 theory analogous to $e^+ + e^-$ → hadron + anything, is examined in ϕ^4 field theory for large values of q^2. Some heuristic arguments as to the strength of mass singularities in a particular two-particle irreducible amplitude make it possible to argue that a light-cone-like expansion exists when $q^2 \to \infty$. This light cone expansion has virtually all of the properties of the usual light cone expansion except that it is not an expansion in terms of invariant amplitudes associated with local operators. In case ϕ^4 theory has an eigenvalue, $\beta(g_{cr}) = 0$, the moments of the annihilation cross section will have a power behavior in q^2, a power unrelated to the powers of q^2 appearing in any deeply inelastic scattering process. Also, at an eigenvalue the average multiplicity of particles produced, a quantity governed by the Callan-Symanzik equation in this theory, grows like a fractional power of q^2. (auth)

11258 (DESY-73-34) PARTON MODEL PREDICTIONS FOR TWO PARTICLE CORRELATIONS IN e^+e^- ANNIHILATION. Walsh, T. F.; Zerwas, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Aug 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

The parton model predicts a jet structure for e^+e^- annihilation into hadrons. This is obscured at low energies by the presence of finite transverse momentum effects. It is suggested studying e^+ +

$e^- \rightarrow h_1 + h_2 + X$, where at least one hadron is near the kinematical boundary; this defines a jet axis. Numerous predictions for correlations among mesons follow from Feynman's parton fragmentation suggestion. Also sum rules are given which check for the quantum numbers of the partons. (auth)

11259 (DESY-73-38) T-CHANNEL SELECTION PRINCIPLES FOR ELECTROPRODUCTION OF PIONS. Kramer, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 14p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The relation between the polarization of the virtual photon in the electroproduction of single pions on nucleons and the normality ($P(-)^j$) of the exchange contribution in the t-channel for high energies is proven and discussed. The relevance of this relation for the reaction $\gamma p \rightarrow \pi^0 p$ is pointed out, and it is shown that it is valid for $E_\gamma = 3$ GeV in a Regge pole model with absorptive cuts. (auth)

11260 (DESY-73-40) TESTING GAUGE THEORIES IN e^+e^- EXPERIMENTS. An Introduction Summary. Dass, G. V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F.R. Germany)). Aug 1973. 29p. Dep. NTIS (U.S. Sales Only) $3.50.

A review is given of the recently discussed tests of the spontaneously broken gauge theories of weak and electromagnetic interactions possible with e^+e^- interactions. Mathematical details are avoided; the emphasis is only on the nature and magnitude of the effects. Topics discussed include: gauge theories; neutral currents; effects of the heavy scalar mesons ϕ – the channels $e^+e^- \rightarrow \mu^+\mu^-$ and $e^+e^- \rightarrow e^+e^-$; and effects of the heavy leptons. (LBS)

11261 (ITF-73-86-P) PROCESSES $\gamma p \rightarrow \pi\Delta$ AND THE CABIBBO–RADICATTI SUM RULES. Zayats, A. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 11p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The contribution of the processes $\gamma p \rightarrow \pi\Delta$ to the Cabibbo–Redicatti sum rules is calculated within the framework of the one-pion gauge-invariant mechanism. The isotopic structure of the amplitude of the process $\gamma p \rightarrow \pi\Delta$ is studied. (auth)

11262 FLUCTUATION OF THE TOTAL MEAN FREE PATH OF CHARGED PARTICLES IN ELECTRON–PHOTON SHOWERS PRODUCED BY γ QUANTA WITH ENERGY OF 40, 60, AND 200 MC^2. Borkovskii, M. Ya.; Kruglov, S. P. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1447-1450(Jul 1973). (In Russian).

Calculations were made by the Monte Carlo method of the average total mean free path and distribution of the total mean free path of charged particles with total energy above 3 mc^2 in electron-photon showers generated by γ quanta with energy of 40, 60, and 220 mc^2 in lead and 200 mc^2 in copper. The calculations were carried out for absorbers of different thickness, varying from 1 to 20 radiation lengths. The results of the calculation of the mean free path for showers caused by electrons were compared with the data of other studies. (tr-auth)

11263 EXTENSIVE AIR SHOWERS AND THE CHARACTERISTICS OF THE NUCLEAR INTERACTION AT SUPERHIGH ENERGIES. Kalmykov, N. N.; Fomin, Yu. A.; Khristiansen, G. B. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1430-1432(Jul 1973). (In Russian).

The validity of the high multiplicity model in the description of extensive air showers is discussed on the basis of experimental data reported in the literature. (J.S.R.)

11264 THEORY OF RADIATION OF CHARGED PARTICLES IN A CRYSTAL. Barysheuski, V. G.; Feranchuk, I. D. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 2, 102-108(1973). (In Russian).

A practical, accurate solution to the problem of transitional radiation of charged particles in crystals of random thickness was obtained using the dynamic theory of diffraction of x-rays and γ-quanta. During motion of a relativistic charge photons were emitted, concentrated not only along the direction of motion of the particle, but also at Bragg angles. In addition, the charged particle may generate both x-ray and resonant γ-radiation in the crystal. (tr-auth)

11265 POSSIBLE IMPLICATIONS OF THE GRIBOV–LIPATOV RECIPROCITY RELATIONS IN INCLUSIVE PROCESSES. Etim, E.; Ferrara, S.; Grillo, A. F. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 8: No. 14, 849-853(1 Dec 1973).

Some of the consequences of the Gribov–Lipatov reciprocity relations for structure functions that will be tested at Frascati and other e^+e^- storage-ring facilities are discussed. A plot of the pion structure functions for various values of the annihilation parameter (n_s) and R is presented, and some distinguishing features are noted. (LBS)

11266 ASYMPTOTIC FORM FACTOR OF A SELF-INTERACTING COMPOSITE FIELD. Rivers, R. J. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B65: No. 1, 29-44 (1973).

The effect of hadronic and electromagnetic unitarity corrections to the form-factor of a self-interacting soft composite field is reconsidered. It is suggested that singularities to remedy the softness can arise from (a) interconstituent electromagnetic interactions, (b) as a consequence of dual or statistical model mass spectra. The implications for the Feynman quark model and dual theory are discussed. (auth)

Weak

11267 (COO-2271-23) WEAK INELASTIC PRODUCTION AND LEPTONIC DECAYS OF HEAVY LEPTONS. Soni, A. (Columbia Univ., New York (USA)). 1973. Contract AT(11-1)-2271. 44p. Dep. NTIS $4.25.

Reactions of the type,

$$\nu(\bar{\nu})N \rightarrow L^\pm + \text{"anything"} \quad \text{and} \quad l^\pm N \rightarrow L^0(\bar{L}^0) + \text{"anything"}$$
$$L^\pm \rightarrow \nu(\bar{\nu}) + l^\pm + \nu_{l^\mp} \qquad L^0(\bar{L}^0) \rightarrow l^\pm + l'^\mp + \nu_{l'^\mp}$$

where L is a lepton heavier than the muon are examined, and expressions are derived for the inclusive cross sections of the outgoing charged leptons. The phase space integration is simplified by neglecting the electron and muon masses and the differential cross section, with respect to the transverse momentum of the charged leptons in the final state. Using a simple parameterization for the hadronic structure functions, results are presented for several incident lepton energies, between 50 and 500 GeV in the lab frame, and, for heavy lepton masses ranging from 2 to 11 GeV, assuming the coupling constant of the heavy lepton to be identical to that of the muon. A simple relation between the differential cross section of the outgoing charged leptons along the beam axis and the total cross section is obtained. Throughout these calculations the effects produced on the spectrum of the final charged lepton by the polarization of the heavy lepton are fully incorporated. (auth)

11268 (HU-TFT-73-21) REGGE–MUELLER VERSUS PARTON MODEL ANALYSIS OF DEEP INELASTIC REACTIONS. Chaichian, M.; Kitakado, S.; Lam, W. S.; Zarmi, Y. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1973. 39p. Dep. NTIS (U.S. Sales Only) $4.00.

The Regge–Mueller expansion of single particle inclusive distributions in deep inelastic lepton-hadron scattering is matched with the $\omega \rightarrow \infty$ limit of the parton model description of the same reaction. Relations and inequalities among couplings and fragmentation functions, which appear also in purely hadronic reactions, are obtained. (auth)

11269 (ITF-73-87-P) LEPTON FORMATION OF W-MESONS. Pyzh, V. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 28p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

The double differential cross sections for the reactions of the lepton formation of vector and scalar charged W-mesons are calculated. The asymptotic expansions of the total cross sections of these reactions for arbitrary values of the anomalous magnetic moment of the vector W-meson are obtained. All the terms which do not decrease with increasing energy are kept in the asymptotics. The results are compared with the available data on the reactions in point. (auth)

11270 (JINR-P2-7490) SEMILEPTONIC AND NONLEPTONIC PROCESSES IN NONPOLYNOMIAL MODEL OF WEAK INTERACTIONS. Abdullaev, F. Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Using the concept about the nonlinear universal coupling of hadrons with f-mesons ("strong gravity" model) the higher orders of the theory of weak four-fermion interactions were studied by the method of nonpolynomial Lagrange field theory. The amplitude of elastic scattering of a neutrino on a nucleon, the mass difference of K_L^0 and K_S^0 mesons, and the corrections to the nucleon masses due to weak interaction are calculated, i.e., those processes are considered whose investigation leads often to the conclusion about the inapplicability of an ordinary form of weak interaction at high energies. The calculation results are in satisfactory agreement with experiment at the massive gravity coupling constant values of $k_f^{-1} \sim (2-3)M_{nucl}$. (auth)

11271 (RLO-2041-94) NON-DYNAMICAL STRUCTURE OF REACTIONS INVOLVING FOUR SPIN-½ PARTICLES. Reid, R. V. Jr.; Moravcsik, M. J. (California Univ., Davis (USA). Dept.

of Physics; Oregon Univ., Eugene (USA)). 1972. 46p. Dep. NTIS $4.50.

The complete spin-structure of the reaction involving four spin-½ particles is given and the consequences of the imposition of various conservation laws are described. The latter yield a complete set of experimental tests for the validity of the conservation laws. (auth)

11272 EFFECTS OF CURRENTS OF THE SECOND TYPE IN THE LEPTON DECAY OF HYPERONS. Lobov, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1532-1536(Jul 1973). (In Russian).

The effects of currents of the second type in $\mu-e$ ratio of the probability of hyperon decay with variation of the strangeness $|\Delta Y| = 1$ were examined theoretically. (tr-auth)

11273 NEUTRINO FORMATION REACTION OF PSEUDOSCALAR MESONS ON NUCLEONS NEAR THE THRESHOLD IN THE REGION OF HIGH MOMENTUM TRANSFER. Krive, I. V. (Kharkov State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1399-1402(Jul 1973). (In Russian).

The reactions $\nu(\bar{\nu}) + N \rightarrow 1^{-}(1^{+}) + B + M$ (B is baryon and M—pseudoscalar meson) at threshole in the region of high transfer were investigated within the framework of the relativistic Born approximation. It was shown that in the considered model it was possible to obtain simple expressions for the cross section ratio of some reactions dependent only on the interaction constant at the strong peak. (tr-auth)

11274 SEMI-LEPTONIC PROCESSES. II. Kawai, E. I.; Ogawa, S.; Yamamoto, Y. I. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2165-2166(Jun 1973).

In order to examine a previously proposed selection rule for the semileptonic decay processes of hadrons more concretely, a prediction is made for the reactions $\nu_\mu(\bar{\nu}_\mu) + M \rightarrow m + B + \mu^{-}(\mu^{+})$, where N is the nucleon, and m and B are the meson and the baryon respectively. (JFP)

11275 NEW CONSTRAINTS FOR THE PARAMETERS OF THE K_{l3} SCALAR FORM FACTOR. Kang, K. (CERN, Geneva); Pham Xuan Yem; Pond, P. Lett. Nuovo Cim.; 8: No. 14, 825-830(1 Dec 1973).

A new theoretical constraint for λ_0 and λ_0' parameters of the K_{l3} scalar form factor is presented based on the low-energy theorems of hard-pion current algebra along with (3*, 3) + (3, 3*) symmetry breaking. The relations obtained for λ_0 and λ_0' reduce to the well-known current algebra relations when the appropriate limits are taken. In particular, it is found that when λ_0 is large and negative, λ_0' must become positive, thus allowing a large family of possible solutions. (LBS)

11276 PREDICTIONS OF THE WEINBERG MODEL FOR NEUTRAL CURRENTS IN INCLUSIVE NEUTRINO REACTIONS. Sehgal, L. M. (Technische Hochschule, Aachen). Nucl. Phys.; B65: No. 1, 141-157(1973).

The consequences of the Weinberg theory for neutral current reactions of the type $\nu(\bar{\nu})$ + nucleon $\rightarrow \nu(\bar{\nu})$ + hadrons are investigated, using a quark parton model. The total cross section ratios $R = \sigma(\nu \rightarrow \nu)/\sigma(\nu \rightarrow \mu^{-})$ and $\bar{R} = \sigma(\bar{\nu} \rightarrow \bar{\nu})/\sigma(\bar{\nu} \rightarrow \mu^{+})$ are obtained as functions of the Weinberg angle θ, and have the minimum values $R_{min} = 0.17$, $\bar{R}_{min} = 0.37$. An approximate relation between R and $\bar{R}$ is obtained, which is independent of the Weinberg angle: $\frac{1}{2}(1 - 3R + \bar{R}) = [27/40(R - \bar{R})]^{1/2}$. Predictions are made for the average ν and average Q^2 in comparison to those in charged current reactions. Preliminary results of the Gargamelle experiment are compared with the theory. (auth)

Strong (General)

Refer also to abstracts 11299 and 11309.

11277 (ITF-73-123-P) VACUUM STATE IN DUAL MODELS. Volkov, D. V.; Zheltukhin, A. A.; Pashnev, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The joint assumption on the presence of particle transition into the vacuum and the duality conception is elucidated. It is shown that the account of particle transition into the vacuum leads to the renormalization of coupling constant, external particle masses, the intercept of the trajectory. (auth)

11278 CORRELATIONS IN RAPIDITY SPACE FOR THE PARTONIC CLUSTER MODEL. Knoth, A. (Universidade Federal do Rio de Janeiro, Guanabara, Brazil). Lett. Nuovo Cim.; 8: No. 14, 857-860(1 Dec 1973).

It is shown that the partonic cluster model can contain three basic interactions, the third being of extremely short range and thus giving extremely short-range correlations in rapidity space. Further it is shown that the partons of the third-class interaction will contribute to the plateau in addition to the contribution from the nondiffractive-scattering mechanism. (LBS)

11279 PATTERNS OF DIFFRACTIVE PRODUCTION. Horn, D. (National Accelerator Lab., Batavia, IL); Moshe, M. Nucl. Phys.; B65: No. 1, 112-130(1973).

Diffractive production is discussed in the context of two-component models. After defining the class of models considered, and discussing their general properties, integral equations are developed for the generating functions of diffractive processes. Single and double diffraction and two fireball productions are considered. The behavior of the partial cross sections for n-particle production in all three cases is investigated and a successful fit to recent data is obtained. (auth)

11280 COLLIDING-REGGE-CUT REPRESENTATION OF THE DUAL ABSORPTION AMPLITUDE. Fujisaki, H. (Rikkyo Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 50: No. 1, 178-181(Jul 1973).

A colliding-Regge-cut representation of the dual absorption model is proposed for the non-Pomeron amplitude at high energies, in the case of logarithmically s-dependent interaction radius. It is argued that our model is free from ghost divergence and compatible with a set of assumptions; (i) dominance of peripheral partial waves at intermediate and high energies, (ii) logarithmic shrinkage of the Regge amplitude at intermediate and high energies and (iii) approximate s-independence of effective radius at intermediate energies. (auth)

Strong (Baryon No. = 0)

11281 (JINR-E2-7508) PION FORM FACTOR WITH GENERALIZED RHO DOMINANCE. Dubnicka, S.; Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

Starting from the once-subtracted dispersion relation and a special expression for the p-wave $I = 1\pi\pi$ scattering phase shift a simple formula for the pion form factor is found which is able to describe the experimental data in space-like and time-like regions simultaneously. The best fit procedure with the ρ-meson mass and width as free parameters gives $m_\rho = 770 \pm 4$ MeV and $\Gamma_\rho = 157 \pm 5$ MeV. The pion's charge radius resulting from the formula is also discussed. (auth)

11282 VENEZIANO MODEL FOR PSEUDOSCALAR–PSEUDOSCALAR SCATTERING AND PARTIAL CONSERVATION OF OCTET AND SINGLET AXIAL-VECTOR CURRENTS. Ino, T. (Shimane Univ., Matsue, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 1, 168-177(Jul 1973).

From the standpoint that Adler's PCAC consistency conditions should be understood as dynamical constraints for the relations among pole residues, Veneziano amplitudes can be constructed for the elastic 0^{-}-0^{-} scattering consistently with the partial conservation of octet and singlet axial-vector currents. Adler's conditions give interesting mass formulas. The predicted mass of of 0^{-} singlet, m_1^2, from the soft-P_1 PCAC condition is near to the one calculated from observed m_π^2, $m_{K^0}^2$, m_η^2 and $m_{K^+}^2$. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 11162.

11283 (JINR-E2-7257) ASYMPTOTIC PROPERTIES OF CHARGE DISTRIBUTIONS. Berceanu, S.; Besliu, T.; Gheorghe, A.; Mihul, A. L. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Some asymptotic properties of charge distributions in hadronic collisions are deduced from the conservation sum rules and model-independent assumptions. It is shown that the invariant charge distributions approach a zero limiting value in the central region at asymptotic energies. Several Pomeranchuk properties of charge distributions, a separate charge conservation in both the c.m. hemispheres, and the vanishing of any charge-exchange cross section (normalized to the corresponding total one) are derived in the limit of infinite incident energy. (auth)

11284 (TID-26495) EVIDENCE FOR TWO-Δ(1236) COMPONENT OF DEUTERON GROUND STATE. Goldhaber, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 4p. Dep. NTIS $3.00.

Comment following talk by I. Butterworth, Aix-en-Provence, September 11, 1973.

It is briefly considered whether the existence of deltas in the deuteron could be more directly demonstrated. (JFP)

11285 REGGE PHENOMENOLOGY IN THE CENTRAL REGION. Sakai, S. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 50: No. 1, 182-186(Jul 1973).

The model which has been proposed to explain the phenomena in the central region is applied to the medium x region ($|x|<0.6$). The model successfully fits the data on $K^+ + p \rightarrow K^0 + "X"$ and $K^- + p \rightarrow \bar{K}^0 + "X"$ in $|x|<0.6$, explains the early scaling in $|x|>0.2$ and can account for the approach to the scaling limit from below at $x = 0$. Except for the region $|x|>0.7$, where two-body or quasi-two-body processes may play an important role, and except for the processes where leading particle effects seem important, the model successfully fits the data. (auth)

11286 CRITERION FOR EARLY SCALING OF INCLUSIVE REACTIONS. Kitakado, S.; Wing-Yin Yu. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 8: No. 14, 831-834(1 Dec 1973).

It is shown that the second duality component contributing to the energy-dependent part of inclusive reactions of the type $ab \rightarrow cX$ vanishes in the fragmentation region. This leads to the criterion that ab exotic is a sufficient condition for early scaling. The reactions $K^+p \rightarrow K^0X$, $\pi^+p \rightarrow \pi^+X$, and $\pi^-p \rightarrow \pi^-X$ are considered as a test of the criterion. (LBS)

Strong (Baryon No. ≥ 2)

11287 (CONF-730642-13) NUCLEON-NUCLEON POTENTIAL THAT INCLUDES THE EFFECT OF THE Δ(1236). Green, A. M.; Haapakoski, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

From fifth international conference on high-energy physics and nuclear structure; Uppsala, Sweden (18 Jun 1973).

A nucleon-nucleon potential that includes the effect of the Δ(1236) A. M. Green and P. Haapakoski (Research Institute for Theoretical Physics, University of Helsinki, Finland) is discussed. A phenomenological interaction is derived by treating the NN and NΔ systems as a coupled channel problem. Two free parameters are adjusted to fit the $\delta(^1S_0)$ of N-N scattering. An equivalent NN interaction is obtained by treating the NΔ system by closure. The $^1S_0$ contribution to the binding energy of neutron matter is then calculated with each of these equivalent potentials. (auth)

11288 (ITF-73-95-P) INTEGRAL EQUATIONS FOR FOUR IDENTICAL PARTICLES WITH SEPARABLE TWO-PARTICLE INTERACTIONS. Kharchenko, V. F.; Kuz'michev, V. E. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The problem of four identical spinless particles with separable two-particle interactions is considered. The integral equations of motion for four particles in the bound states and in the continuum states with two noninteracting subsystems in the initial channel are formulated. The angular-momentum reduction of the obtained equations is given. (auth)

11289 (ITF-73-122-P) ZERO-ENERGY KAON-DEUTERON ELASTIC SCATTERING. Zasenko, V. I.; Peresypkin, V. V.; Petrov, N. M. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Using the Faddeev integral equations the problem of elastic scattering of zero-energy K^+-mesons by deuterons is considered. It is supposed that the two-body interaction is only in the S-state and is described by a one-term interaction potential with separable variables. The dependence of the K^+-d scattering length on the form of the two-body interaction and on the value of isosinglet K^+-N scattering length is studied. (auth)

11290 (JINR-P2-7324) CHARGE EXCHANGE OF FAST NUCLEONS ON DEUTERONS IN THE GLAUBER THEORY. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The exchange scattering of neutrons on deuterons was previously studied by I. Ya. Pomeranchuk, I. M. Shmushkevich, L. I. Lapidus. It was shown that the study of this process gives some information on the spin-dependence of the exchange forces. The charge-exchange process pd → n(pp) in the Glauber theory is analyzed when the spin dependence of NN-amplitudes is taken into account. It is shown that the forward differential cross section of this process at high energies is defined by the spinflip parts of the forward amplitude of the p-n charge-exchange process: $[d\sigma/d^{d\to n(pp)}/d\Omega] = (2/3)(2|b_c^2| + |f_c^2|)\{1 - (1/4\lambda)\langle r^{-2}\rangle (\sigma_{tot}^{pp} + \sigma_{tot}^{pn})\}$, where b_c, f_c are the spin-flip parts of the forward amplitude of the p-n charge-exchange process. One can calculate, with the help of this formula, the value of the contribution of the spin-dependent part of the forward differential cross section of the p-n charge-exchange process at high energies ($T_p > 1$ GeV). The Glauber corrections are about 20%. (auth)

11291 (LA-5424-MS) μ-CAPTURE AND THE n-n SCATTERING LENGTH. Gibson, B. F.; Stephenson, G. J. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The capture reaction $\mu^- + d \rightarrow n + n + \nu$ is examined with the objective of obtaining a precise measurement of the n-n scattering length. Differential time-of-flight neutron spectra for the two-neutron coincidence experiment are calculated to illustrate the sensitivity of the reaction to a_{nn}. The dominant theoretical uncertainty lies in the unknown short-range character of the n-n scattering wave functions as it does for competing reactions such as radiative π-capture. (auth)

11292 (NP-19891) DISTRIBUTIONS IN A TWO-COMPONENT MODEL. Research Report No. 14/1973. de Groot, E. H.; Kajantie, K.; Ruuskanen, P. V. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Jul 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

Proton and pion distributions and multiplicities are analyzed in a two-component model in which the diffractive component is given on the basis of the pionization component by assuming that a Pomeron-particle collision behaves as a particle-particle collision. For the pionization component a simple but general ansatz with leading protons is used. Particular attention is given to analyzing the dependence of the diffractive pion spectrum and multiplicity on the behavior of the throughgoing proton. Correlations among diffractively produced pions are shortly considered. Single particle distributions are compared with experimental data from CERN ISR. (auth)

11293 POLARIZATION EFFECTS IN REACTIONS OF THE INELASTIC SCATTERING OF PROTONS. Chegoryan, M. A.; Lopatko, I. D.; Slabospitskii, R. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1522-1526(Jul 1973). (In Russian).

General formulas connecting the analyzing capacity with the amplitude of the reaction were reported. It was shown that in resonance nuclear reactions in the case of isolated resonances or resonance interference of the individual integrity in the reaction channel the vector analyzing capacity is zero. A method for the processing of experimental data by measurement of the asymmetry in the angular distribution of inelastic scattering of polarized protons was discussed. (tr-auth)

11294 INELASTIC INTERACTION OF NUCLEONS AT ENERGY OF 200 GEV. Lebedev, A. M.; Slavatinskii, S. A. (Lebedev Inst. of Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1392-1395(Jul 1973). (In Russian).

The results of the calculation of the characteristics of nucleon-nucleon interactions at an energy of 200 GeV, carried out by the mathematical simulation method in accordance with the theory of multiperipheral interactions, were reported. The characteristics obtained were compared with experimental data on the interaction of nucleons of cosmic radiation with nuclei of light material at this energy. (tr-auth)

11295 MULTIPLICITY IN DIFFRACTION DISSOCIATION PROCESSES AT HIGH ENERGIES. Matinyan, S. G.; Pirogov, Yu. F. (Inst. of Physics, Erevan). JETP Lett. (USSR) (Engl. Transl.); 18: No. 6, 226-227(20 Sep 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 6, 385-387(20 Sep 1973).

The contribution of the three-pomeron mechanism to the average multiplicity of hadrons produced at high energies is studied. It is shown that this mechanism leads to a doubly-logarithmic contribution $\langle n\rangle_D \simeq 10^{-2} a \ln^2 s/s_0$ in addition to the contribution $\langle n\rangle \simeq a \ln s$ of the multiperipheral mechanism. The connection with other fragmentation models is discussed. (auth)

11296 ELECTROMAGNETIC SHIFT OF POMERANCHUK TRAJECTORY. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys.; B65: No. 1, 70-76(1973).

Electromagnetic shift of the Pomeranchuk trajectory is calculated at $t = 0$ through its virtual dissociation into a photon and a vector meson. A numerical estimate using the data of vector meson production by electrons leads to the effective electromagnetic upward shift of the intercept $\Delta\alpha_p(0) \simeq 0.0023$. It corresponds to $\Delta\sigma_{tot} \simeq 0.6$ mb for the proton-proton collision at the highest ISR energy available, $s = 4 \times 10^3$ GeV^2. (auth)

11297 INTERPRETATION OF WHITE STAR EVENTS IN EMULSION. Schaffner, J. G.; Trefil, J. S. (Univ. of Virginia, Charlottesville). Nucl. Phys.; B65: No. 1, 242-252(1973).

It is shown that events in emulsion which have no heavily

ionizing tracks and which are sometimes assumed to be associated with hydrogen nuclei are in fact dominated by coherent production from heavy nuclei in the emulsion. This mechanism explains the dramatic increase of such events with energy. (auth)

11298 MODEL SIMULATION OF FOUR-PRONG p–p INTERACTION AT A MOMENTUM OF 19.1 GeV/c. Boos, E. G.; Zhautykov, B. O.; San'ko, L. A.; Kuz'mina, V. L. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 67/70(1972). (In Russian).

The distribution of the effective masses of different combinations is discussed and compared with curves as calculated from an invariant phase volume. A conclusion is reached regarding the angular distribution of protons in a center-of-mass system. The contribution of proton distribution was evaluated for a choice of conditions with a maximum momentum in the center-of-mass system. (tr-auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 11721 and 11726.

11299 (CERN-73-15) SCALING PROPERTIES AND THE BOUND-STATE MODEL OF PHYSICAL BARYONS. Lee, T. D. (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Nov 1973. 17p. Dep. NTIS (U.S. Sales Only) $3.00.

The scaling hypothesis is stated in a form different from its original formulation, which means simply the absence of any basic physical energy scale. This enables the various cross sections at a relatively low-energy range to be connected to those at a much higher energy range by a simple scale transformation. A simple bound state model is considered to illustrate how the strong interaction of a physical nucleon can be described by a super-renormalizable force. A new basic energy scale, higher than that yet discovered is conjectured. (LBS)

11300 NON-INVARIANCE GROUPS IN PHYSICS AND CHEMISTRY: THE O(f,2) ALGEBRA AND THE SPHERICAL HARMONICS IN f DIMENSIONS. Herrick, D. R.; Sinanoglu, O. (Yale Univ., New Haven). Rev. Mex. Fis.; 22: No. 1-2, 1-14(1973).

The concept of a non-invariance group is presented by constructing a Lie algebra representation of the non-compact group O(f,2) on the f-dimensional spherical harmonics. Applications of the analysis are made on the bound state Kepler problem in f-1 dimensions, and by constructing the angular portion of the dipole operator with the generators of the O(f,2) algebra. Uses of non-invariance groups in chemistry are discussed. (auth)

Applications (Electromagnetic and Weak)

11301 SCALING BREAKDOWN AND THE FINITENESS OF THE PROTON–NEUTRON MASS DIFFERENCE. Tataru-Mihai, P. I. (Univ., Cluj). Lett. Nuovo Cim.; 8: No. 14, 854-856(1 Dec 1973).

The question on the finiteness of the proton–neutron mass difference is analyzed using a recent discussion on a possible breakdown of Bjorken scaling due to Chanowitz and Drell (SLAC-PUB-1201, March 1973). The discussion reveals a possible test to the Chanowitz–Drell conjecture. (LBS)

Applications (Strong)

11302 STATISTICAL MODEL OF $\bar{p}p$-ANNIHILATION AT REST. Rus'kii, V. I.; Gridneva, S. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 59-63(1972). (In Russian).

A statistical model for describing $\bar{P}P$-annihilation at rest was applied with and without the formation of K-mesons. Allowance was made for the conservation of P-, G-, and C-parities. (tr-auth)

Scattering Theory

Refer also to abstracts 11280 and 11727.

11303 (JINR-E2-7461) LORENTZ-INVARIANT EXPANSION OF THE SCATTERING AMPLITUDE FOR PARTICLES OF ANY SPIN. Aneva, B. L.; Mavrodiev, S. Sh.; Hadjiivanov, L. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 40p. Dep. NTIS (U.S. Sales Only) $4.00.

Expansion of the scattering amplitude for particles of any spin in invariant structures is performed in terms of complex spinors on the basis of full Lorentz group representations. (auth)

11304 (JINR-E4-7535) SOLUTION OF THREE-DIMENSIONAL LIPPMAN–SCHWINGER EQUATION WITHOUT PARTIAL-WAVE EXPANSION. Belyaev, V. B.; Irgaziev, B. F.; Wzecionko, J. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U.S. Sales Only) $3.00.

A method for solving three-dimensional Lippmann–Schwinger equation, good for short-range potential, is presented. The method allows one to solve the scattering problems in the region of intermediate and high energies and to describe the motion of a particle in the noncentral fields. For the Gaussian potential scattering the resulting amplitude is compared with the Born and eikonal amplitudes. (auth)

11305 (JINR-P4-7437) GENERALIZATION OF THE PHASE FUNCTION METHOD IN THE POTENTIAL SCATTERING THEORY. Babikov, V. V.; Khankhasaev, M. Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An approach in the theory of potential scattering at high energies which is based on the generalization of the phase function method is described. A nonlinear integral-differential equation is deduced for the scattering amplitude. The equation is valid without any restrictions to the potential symmetry. (auth)

11306 DISCRETE AMBIGUITIES AND EQUIVALENT POTENTIALS. Sabatier, P. C. (Univ., Montpellier, France). Phys. Rev., A; 8: No. 2, 589-601(Aug 1973).

Ambiguities arising in the construction of potentials from the scattering amplitude at a given energy are studied. The functional space of all possible potentials is explored in general by means of the JWKB approximation and in particular by the generalized Born approximation. Typical kinds of ambiguities are exhibited. Certain of them ("window" ambiguities) arise from the fact that wave functions are unable to test analytical details over distances much smaller than a wave length. Others are owing to the parts of the potential that are located between turning points and therefore not "visible" in the classical limit. These parts can be deformed slightly without perturbing the phase shifts (continuous ambiguity) and besides can also be modified drastically so as to include more nodes of the wave function. This strong modification yields classes of equivalent potentials which are layered near the origin. As a first approximation, it is very remarkable that the layering does not depend on any detail of the shape of the potential. (auth)

11307 SCATTERING BY A SPIN-DEPENDENT SPHEROIDAL POTENTIAL. Li, M. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Math. Phys. (N.Y.); 14: No. 10, 1358-1363(Oct 1973).

The scattering by a spin-dependent spheroidal potential is studied. For this potential the scattering amplitude is considerably simple. The simplification is accomplished through the use of "recurrence relations" among the spheroidal functions. An iteration procedure is used for solving the infinitely coupled integral equations of the radial functions. The convergence of the solutions is proved. (auth)

11308 EFFICIENT PARTIAL-WAVE ANALYZER FOR THE ABSORPTION MODEL. Collins, P. A. (Imperial Coll. of Science and Tech., London); Hartley, B. J.; Moore, R. W.; Moriarty, K. J. M. Comput. Phys. Commun.; 5: No. 5, 349-364(May 1973).

This program is concerned with the phenomenological analysis of high-energy two-body scattering processes in terms of the absorption model. Rather than employ the impact-parameter representation and the subsequent approximations required by such a procedure, the program expands the s-channel helicity amplitudes in exact partial-wave series, modifies the partial wave amplitudes according to the absorption model prescription and resumes the series to obtain the modified amplitudes. (LBS)

11309 OFF-MASS-SHELL DUAL AMPLITUDES WITHOUT GHOSTS. Schwarz, J. H. (California Inst. of Tech., Pasadena). Nucl. Phys., B65: No. 1, 131-140(1973).

A new approach to the construction of off-shell dual amplitudes and hadronic currents is presented. The guiding principle in this work is the manifest incorporation of the Virasoro gauge conditions. This requirement is so stringent that we are only able to find a solution for a particular dimension of spacetime: 16 in the case of an off-shell scalar in the Veneziano model. Furthermore, the amplitude for one off-shell state and an arbitrary number of on-shell states turns out to be given by a logarithmically divergent integral, although it is quite well-behaved in all other respects. It is suggested that the divergence problem might not occur for a ghost-free model with $\alpha(0) < 1$, and that suitable modification of the model can bring the dimension selected by the currents into

coincidence with the critical dimension. These requirements could lead a long way toward determining a unique model. (auth)

11310 LINKED CLUSTER DECOMPOSITION OF AN S MATRIX. Generalization of the Eikonal Approximation. Obu, M. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 50: No. 1, 147-167 (Jul 1973).

An S matrix for potential scattering is decomposed into an infinite product form with each factor representing the contributions from "linked clusters." The linked clusters are defined in the framework of the time-dependent formal scattering theory as multifold commutators of the time-dependent interaction Hamiltonian. It is emphasized that in dealing with high-energy scattering by a smooth potential the linked cluster decomposition provides us with rapid convergence. In fact even the first approximation ("one-body" cluster contribution) is shown to be a geometrical generalization to the ordinary eikonal approximation. The convergence is tested numerically for Yukawa potentials. (auth)

11311 BILOCAL FORM FACTORS AND REGGE COUPLINGS. Kleinert, H. (Freie Univ., Berlin). Nucl. Phys., B65: No. 1, 77-111(1973).

The infinitely many local observables defined by expanding the bilocal currents $j^{\mu}(x,y)$ on the light cone in powers of $(x-y)^{\mu}$ are used to study scattering processes where one or two external lines are Reggeons. The algebra of bilocal form factors of Fritzsch and Gell-Mann implies the existence of an algebra of infinitely many form factors $F^{J\pm}(k)$ of any spin J, definite signature ±, and arbitrary momentum transfer k. These "signatured form factors" can be continued analytically in k as well as in J and superconvergence relations are obtained for the couplings of strongly interacting particles of arbitrarily high spin and for Regge couplings. Also the commutator of form factors with Regge residues vanishes, except at certain momentum transfers. In particular, the charges $F^{J\eta}(0)$ of spin J and signature $\eta = (-)^J$ act as "daughter lowering operators". The range of validity of these sum rules in momentum transfer is discussed by continuing the scattering amplitudes involving the spin J and spin J′ currents analytically in J and J′. When the sum rules break down one can truncate the intermediate sums at some value of the intermediate masses. In this way one obtains an algebraic form of finite-energy sum rules. They consist in commutation rules among Reggeons with the right-hand side being given by the Regge couplings that can be exchanged in the corresponding scattering process. The structure constants of this algebra are the corresponding triple-Regge couplings. As an example one may assume dominance of leading trajectories and finds that ρ, A_1, π and f residues commute like O(5). Including also the commutators with vector and axial vector charges, one obtains the "supergroup" $SU(2) \times SU(2) \times O(5)$. The Regge couplings dealt with here are all in the infinite-momentum frame. In order to give the connection with standard t-channel couplings the angular condition for bilocal form factors are derived and continued in angular momentum. As another technical side results it is pointed out that under very weak assumptions the bilocal form factors F(k,z) are analytic in z. F(k,z) does not, however, possess Regge behavior for $|z| \to \infty$ as often stated. Only signatured bilocal form factors do, as shown in this work. (auth)

11312 OFF-ENERGY-SHELL CONTINUATION OF THE TWO-BODY TRANSITION MATRIX IN THE IMPACT PARAMETER REPRESENTATION. Bhatt, S. C. (Univ. of Alberta, Edmonton). Nucl. Phys.; A217: No. 3, 491-504(1973).

In the impact parameter representation, the symmetric part $\sigma(k', b, k)$ of the half-shell T-matrix, H, can be given arbitrarily. This in turn determines the entire T-matrix. Since $\sigma(k, b, k)$ is essentially the impact parameter phase shift, the arbitrary part of the T-matrix appears to be a continuation into two dimensions of the phase shift function with symmetry being the only restriction. Since one can work with the T-matrix instead of the potential V, the formalism stays closer to experiments. Only two assumptions are necessary, namely, high energy and small intermediate angles. (auth)

11313 CROSSING MATRIX, KINEMATICAL SINGULARITIES, AND REGGEIZATION FOR THE SIX-BODY HELICITY AMPLITUDE. Inagaki, H. (Tokyo Metropolitan Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 1, 187-213(Jul 1973).

The six-body helicity amplitude of massive particles is treated and its various properties including crossing relations, kinematical singularities and Reggeizations are studied. Applications are made to the one-particle inclusive reaction and the inclusive polarization and many interesting results are obtained which cannot be seen in four-body case. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

11314 (COO-1569-100) OBSERVATION OF CIRCULATION IN ROTATING SUPERFLUID HELIUM. Kral, S. F. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). Mar 1973. Contract AT(11-1)-1569. 163p. Dep. NTIS $10.25.

Thesis.

Measurements of the circulation of the superfluid component of He II around a fine wire stretched along the axis of a cylindrical container have been made while the container and wire were in rotation. These measurements form an extension of earlier measurements made in our laboratory of the circulation around a fine wire in a similar container, but with the container and wire at rest. The method of W. F. Vinen is used, in which the circulation is measured by means of the influence it has on the transverse vibrations of the wire. Measurements were made at temperatures near to 1.30 K for rotation speeds in the range from 0 to ±4 rad/sec, and for wire diameters ranging from 60 to 90 μm. Both the magnitude and direction of the circulation were obtained. Two principal results are found. The first is that at a given rotation speed the circulation exhibits a high degree of metastability, with the metastable values found being at both integer and non-integer multiples of the circulation quantum h/m. In addition, at a given rotation speed the metastable values cover a range of circulation values, and the center value of this range increases as the rotation speed increases. The second principal result is that as the rotation speed is changed continuously the circulation exhibits a series of step-like changes between metastable levels. These metastable levels appear at both integer and non-integer multiples of the circulation quantum. (MHR)

11315 (COO-1569-103) FLUCTUATION EFFECTS ON THE CONDUCTIVITY OF Nb AND NbN FILMS. Chard, L. A. (Minnesota Univ., Minneapolis (USA)). Jul 1973. Contract AT(11-1)-1569. 78p. Dep. NTIS $6.00.

Thesis.

Standard four-terminal resistance measurements were done on sputtered Nb and NbN films to study the effect of fluctuations on the electrical conductivity. For one of the NbN samples, data were also taken in perpendicular magnetic fields up to 60 kG. Agreement of the data with the theory was only qualitative. The zero field data seemed to indicate a change in sample dimensionality—a behavior also observed in the magnetic field data. However, the change took place at values of the magnetic field higher than predicted by theory. One way of reconciling this apparent discrepancy is to use in the theoretical expressions a smaller film thickness than that measured. This suggests that the granular structure of the superconductor affected the super-conducting transition of the samples. This interpretation is supported by the high activation energy of the normal resistance as determined from the perpendicular field data. Even with this adjustment, however, difficulties remained. The behavior of the refractory films used here appears to be more complex than the description provided by the theory for homogeneous superconductors. (auth)

11316 (COO-1569-110) THEORY OF PHASE SEPARATION IN QUANTUM CRYSTAL ALLOYS. Huang, W. (Minnesota Univ., Minneapolis (USA)). Dec 1973. 65p. Dep. NTIS $5.25.

Thesis.

Solid mixtures of isotopic helium separate into a ^{3}He-rich phase and a ^{4}He-rich phase at temperatures below 0.5°K and near melting pressure. This phenomenon was understood since I. Prigogine as a result of the volume effect due to the different zero-point kinetic energies of the two isotopic atoms in the mixture. A semiclassical theory was proposed by W. Mullin in which the volume effect was taken into account. A theory based on first principles of the quantum mechanics is proposed and this theory contains Mullin's theory as a special case. The theory starts with a set of localized states, in one of such states each atom is localized around a lattice site. The proper states of the solid mixture are described by linear combinations of these localized states. The free energy and henceforth other thermodynamic properties are obtained by calculating the energy and the entropy of the solid mixture, utilizing the localized states. Two mutually equivalent methods are proposed to calculate the energy and entropy. In the first method use is made of a combinatorial analysis which inspired the invention of the second method in which the free energy is calculated within a restricted ensemble. Both methods yield correct thermodynamics of the phase separation. The quantities involved in the expression of the free energy are full many-body integrals with a clear physical meaning: each site is partially occupied by a ^{3}He wavefunction and partially by a ^{4}He wavefunction. This result may hopefully explain why the exchange energies in a mixture solid helium do not depend on ^{3}He concentration strongly. (auth)

11317 (JINR-P3-7519) ELEMENTARY EXCITATION SPECTRUM AND BOSE-CONDENSATE IN SUPERFLUID HELIUM. Kozlov, Zh. A.; Parfenov, V. A.; Sidzhimov, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The experimental results on slow neutron scattering in liquid helium at temperatures of 1.2 and 4.2°K are discussed for the region of momentum (1.2-35) $Å^{-1}$ and energy transfer (0.3 to 1000) MeV. The measurements were performed with a time-of-flight spectrometer DIN-1M at the impulse fast reactor IBR-30. For one-photon excitations the dependences of the lifetime and scattering cross sections on the momentum are obtained. The dependences of the position and the width of the high-energy peak on the momentum are presented. (auth)

11318 ROLE OF GORTER–MELLINK MUTUAL FRICTION IN COOLING BY FORCED SUPERFLUID FLOW. Olijhoek, J. F.; Van Beelen, H.; De Bruyn Ouboter, R.; Taconis, K. W. (Univ., Leiden, Netherlands). Physica; 69: 38-48(Oct 1973).

Experiments on the flow of He II under high overall pressure through a thermally isolated system consisting of a superleak, a chamber, and a capillary in series are reported. Depending on the direction of the flow a cooling or a warming up of the chamber occurs. The Gorter–Mellink mutual friction gives an adequate description of the phenomena observed. The occurrence of a limiting temperature for cooling of about 0.75 K can be ascribed to heat input into the chamber generated by the flow either in the chamber itself or in the capillary. (auth)

11319 THERMODYNAMIC PHENOMENA ON VORTEX LINES IN SUPERFLUID HELIUM. Shikin, V. B. (Physical-Technical Inst., Kharkov). Solid State Commun.; 13: No. 9, 1303-1305 (1 Nov 1973).

Observations of thermodynamic phenomena on vortex lines in liquid helium are reported. In all these effects helium ions strongly coupled to vortex lines and to thermal excitations localized on these lines are involved. (auth)

Superconductivity

11320 (COO-3169-17) STUDY OF THE INTERACTION BETWEEN MAGNETIC FLUXOIDS AND CRYSTAL DEFECTS IN TYPE II SUPERCONDUCTORS. Kramer, E. J. (Cornell Univ., Ithaca, N. Y. (USA). Dept. of Materials Science and Engineering). 31 Oct 1973. Contract AT(11-1)-3169. 31p. Dep. NTIS $3.75.

Irradiation by fast neutrons at 4.2°K has been shown to decrease the pinning effectiveness of cell walls in Nb whereas both 4.2°K and room temperature neutron irradiation increase the pinning force density F_p at low reduced field h in annealed Nb. Room temperature neutron irradiation also increases F_p in Nb–10 Mo but the F_p vs h curve which develops is much broader than that in Nb at a comparable dose. These differences can be attributed to the much higher density of "black spot" damage observed in Nb–10 Mo with electron microscopy. All irradiated samples obey the microstructural pinning rules predicted by the model of flux pinning for hard superconductors developed last year. These pinning rules also have been tested and found satisfactory for materials where the dominant pinning centers are grain boundaries, precipitates, particles, and dislocation cell walls. The magnitude and h dependence of F_p at high fields is correctly predicted by the model for a wide variety of materials, but interesting deviations occur, perhaps because of fluctuations, at high reduced temperatures in materials with small thermodynamic critical fields. (auth)

11321 (N-73-20794) HIGH-FIELD SUPERCONDUCTIVITY IN ALKALI METAL INTERCALATES OF MoS_2. Woollam, J. A.; Flood, D. J.; Wagoner, D. E.; Somoano, R. B.; Rembaum, A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 14p. (NASA-TM-X-68206). NTIS $3.00.

From meeting of the American Physical Society; San Diego, California, USA (19 Mar 1973).

In the search for better high temperature, high critical field superconductors, a class of materials was found which have layered structures and can be intercalated with various elements and compounds. Since a large number of compounds can be formed, intercalation provides a method of control of superconducting properties. They also provide the possible medium for

excitonic superconductivity. Results of magnetic field studies are presented on alkali metal (Na, K, Rb, and Cs) intercalated MoS_2 (2H polymorph). (STAR)

11322 (N-73-26767) THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF SUPERCONDUCTIVITY, AMORPHOUS SEMICONDUCTORS, SUPERCONDUCTIVITY, AND MAGNETISM. Final Reports, 1 March 1963–28 February 1973. Cohen, M. H. (Chicago Univ., Ill. (USA)). 28 Feb 1973. 21p. (NASA-CR-133234). NTIS $3.25.

The research activities from 1 March 1963 to 28 February 1973 are summarized. Major lectures are listed along with publications on superconductivity, superfluidity, electronic structures and Fermi surfaces of metals, optical spectra of solids, electronic structure of insulators and semiconductors, theory of magnetic metals, physics of surfaces, structures of metals, and molecular physics. (STAR)

11323 (RLO-2225-T-13-19) STUDY OF PHASE TRANSFORMATIONS AND SUPERCONDUCTIVITY. Annual Progress Report. Chandrasekaran, V.; Cotton, W.; Narasimhan, S.; Taggart, R.; Polonis, D. H. (Washington Univ., Seattle (USA). Coll. of Engineering). 15 Oct 1973. Contract AT(45-1)-2225. 73p. Dep. NTIS $5.75.

The electrical resistivity of beta stabilized titanium alloys was examined to determine the influence of the constitution and microstructure on the temperature coefficient of resistivity. A kinetic study was undertaken to determine the effect of vacancies, composition fluctuations, and plastic deformation on the progress of the omega precipitation reaction. The superconductivity studies concentrated on the effects of microstructure on the magnetization behavior of alloys and the influence of alloy chemistry on the transition temperature of ternary alloys based on titanium. The origin of the flux instabilities in beta stabilized alloys containing dispersed omega and alpha particles was identified with the eddy currents induced in these particles during field increments. The experimental work has shown that deformation prior to aging is a significant factor controlling the kinetics of precipitation in Zr–Nb alloys as well as the size and distribution of the precipitate omega particles available for flux pinning. The critical temperature measurements have shown that the electron : atom ratio is not a sufficient criterion to determine the composition corresponding to the maximum value of T_c in an alloy system. The design and assembly of a facility for the measurement of critical current values has been completed. (MHR)

11324 (SLAC-Trans-161) FIELD EMISSION, THE NOTTINGHAM EFFECT, AND ENHANCEMENT OF A MAGNETIC FIELD IN LEAD OR NIOBIUM SUPERCONDUCTING CAVITIES. Chapter 2. Heating of Superconducting Asperities by the Nottingham Effect in Intense High Frequency Fields. Bergeret, H. [nd]. Translated by H. Hobart From a Doctoral Dissertation Presented to the University of Paris, Orsay Center. 43p. Dep. NTIS $4.25.

Field emission has been studied by either x-ray observation or by the frequency shift it produces. Until the present, a single mechanism has been evoked to explain losses in the presence of emission, that is, the transfer of part of the high frequency energy to kinetic energy in the electrons injected into the cavity at the tips of the asperities. On this subject, there exist only a few brief numerical evaluations. Here, a very different type of loss is proposed, tied to energy exchanges between the electrons of the superconductor and the emitted electrons, that is to say, by the Nottingham effect. At the outset the current emitted from an ellipsoidal microprojection is calculated [asperity, or whisker] in a system suitable for justifying this estimate at high frequencies; then the Nottingham effect is introduced. Finally, it is demonstrated that the heating brought about by the energy loss of the Nottingham effect operates in certain cases to transform the superconducting asperities to the normal state. (auth)

11325 AMPLITUDE-DEPENDENT INTERNAL FRICTION IN SUPERCONDUCTING AND NORMAL INDIUM. Platkov, V. Ya.; Polunina, L. N.; Startsev, V. I. (Physical-Technical Inst. of Low Temperatures, Kharkov). Sov. Phys.-Solid State (Engl. Transl.); 14: No. 9, 2400-2401(Mar 1973).

Translated from Fiz. Tverd. Tela; 14: No. 9, 2772-2774(Sep 1972).

A study was made of the influence of temperature on the amplitude-dependent absorption of ultrasound (7.5 MHz) in normal and superconducting in single crystals. Results can be explained by mechanical detachment of dislocations from their pinning centers. (DLC)

11326 DECAY OF SUPERCONDUCTIVE STATE IN QUASI-ONE DIMENSIONAL SYSTEMS. Lukin, V. P.; Tulub, A. V. Vestn. Leningrad. Univ., Fiz., Khim.; No. 10, 7-18(May 1973). (In Russian).

The decay of nonzero supercurrent state in quasi-one-dimensional systems is investigated. The resistive state is described in terms of the formation of "critical droplets" of the normal phase which appearance leads to the instability of the supercurrent state. The nonzero current resistive state represents the periodical lattice in which the superconducting region is followed by the normal one. A phenomenological mean field theory, i.e., the Ginzburg–Landau equations, is used. (auth)

11327 EXPERIMENTAL STUDY OF PROPAGATION OF A NORMAL ZONE IN COMPOSITE SUPERCONDUCTORS. Altov, V. A.; Kremlev, M. G.; Sytchev, V. V.; Zenkevitch, V. B. (Physical Technical Inst. of High Temperatures, Moscow). Cryogenics; 13: No. 11, 644-650(Nov 1973).

The technique and results of an experimental study on the propagation of normal zones under nonequilibrium conditions in composite superconductors are described. Bifilar windings of these superconductors were separated from the power source by a uniform magnetic field to allow the characteristic features of propagation to be studied. Normal zones were produced by heating elements. The experimental results obtained are compared graphically with theoretical results derived previously. (auth)

11328 EXPERIMENTAL INVESTIGATION OF MAGNETIC FIELD DEPENDENCE OF SUPERCURRENT IN MULTIPLY CONNECTED SUPERCONDUCTING FILMS. Bhatnagar, A. K. (St. John's Univ., Jamaica, NY); Stern, E. A. Phys. Rev., B; 8: No. 3, 1061-1079(1 Aug 1973).

Measurements of supercurrent density in thin films of tin were made as a function of externally applied magnetic fields. Following the suggestion of Fulde and Ferrell (Phys. Rev., 131: 2457(1963)), multiply connected sandwich-type samples of low self-inductance were prepared in order to observe the theoretically predicted gradual decrease of supercurrent due to depairing of superconducting pairs as the magnetic field is increased. Samples of low self-inductance are necessary to modify the normally observed first-order superconducting transition to a second-order one. Using samples of a suitable geometry, observations were made of both total disappearance of supercurrent due to complete electron depairing in tin films and also the change from first- to second-order of the superconducting transition induced by an external magnetic field. Various experimental checks were made to verify that the decrease in supercurrent with increasing magnetic field was due to depairing and not spurious effects. The data were analyzed to deduce supercurrent density versus the vector potential, the critical vector potential at which complete depairing takes place, the maximum current density, and their temperature dependences. The quantitative agreement between the experimental results and the predictions of the Ginzburg–Landau theory and its microscopic extensions is reasonably good. (4 tables, 8 figures, 34 references) (auth)

11329 FLUCTUATIONS IN THE ELECTRICAL CONDUCTIVITY OF QUENCH-CONDENSED Nb FILMS. Kawaguti, T.; Shibuya, Y. (Kyushu Univ., Fukuoka). Phys. Lett.; 45A: No. 5, 395-396(22 Oct 1973).

Resistive transitions of niobium films evaporated onto the substrate at cryogenic temperatures were investigated. The Maki–Thompson term gives a contribution to the excess electrical conductivity of highly disordered Nb film. (auth)

11330 SUPERCONDUCTIVITY IN TERNARY ALLOYS OF TRANSITION METALS. Miedema, A. R.; Van Maaren, M. H. (Philips Research Labs., Eindhoven, Netherlands). Physica; 69: 308-316(Oct 1973).

Predictions are made on the concentration dependence of the transition temperature for superconductivity, T_c, in ternary solid solutions of transition metals. Use is made of a model which has recently been shown to give a fair account of properties of binary transition-metal alloys; the metals in an alloy are considered to contribute individually to the density of states at the Fermi level. It is found that in ternary disordered alloy systems T_c values do not exceed the highest value of one of the three corresponding binary systems. A number of examples are given from which it can be seen that considerable variations in T_c are possible in ternary alloys for which the average number of electrons per atom, Z_{av}, is kept constant. (auth)

11331 CRITERIA FOR SUPERCONDUCTING TRANSITION TEMPERATURES. Matthias, B. T. (Univ. of California, San Diego, La Jolla). Physica; 69: 54-56(Oct 1973).

Crystallographic instabilities seem to be a necessary condition for high superconducting transition temperatures in multicomponent phases. (auth)

11332 AC SUSCEPTIBILITY OF METALS IN THE NORMAL OR SUPERCONDUCTING STATE. Van de Klundert, L. J. M.; Gijsbertse, E. A.; Van der Marel, L. C. (Technische Hogeschool Twente, Enschede, Netherlands). Physica; 69: 159-170(Oct 1973).

Models describing the ac behavior due to surface superconductivity can be extended to include frequency effects. It is necessary to take normal currents into account and to assume that superconducting currents can only change under the influence of electrical fields. The model has been verified by means of susceptibility measurements and direct observation of the local b-h loops. (auth)

11333 ABSENCE OF AN S-BAND ENERGY GAP IN NIOBIUM. Frommer, M. H.; Bostock, J.; Agyeman, K.; Rose, R. M.; MacVicar, M. L. A. (Massachusetts Inst. of Tech., Cambridge). Solid State Commun.; 13: No. 9, 1357-1359(1 Nov 1973).

No evidence for a superconducting tunneling s-band energy gap in single crystal Nb has been observed for any of the main symmetry directions investigated in Nb/oxide/$Pb_{0.7}Bi_{0.3}$ and Nb/oxide/In junctions. (auth)

11334 SUPERCONDUCTIVITY AND PHASE STABILITY OF SELENIUM AT HIGH PRESSURES. Moodenbaugh, A. R.; Wu, C. T.; Viswanathan, R. (Univ. of California, La Jolla, San Diego). Solid State Commun.; 13: No. 9, 1413-1416(1 Nov 1973).

Hexagonal Se shows no indication of a transformation to a metallic, superconducting phase up to 160 kbar. Amorphous Se transforms at about 130 kbar to an unstable metallic, superconducting state which anneals slowly at room temperature toward a nonmetallic, non-superconducting phase. Monoclinic Se behaves much like amorphous Se. X-ray diffraction indicates that all samples are in the hexagonal phase after release of pressure. (auth)

11335 DIFFRACTION-LIKE EFFECT ON J_c–H CHARACTERISTICS OF THIN FILM TYPE 2 SUPERCONDUCTOR. Yamashita, T.; Onodera, Y. (Tohoku Univ., Sendai). Solid State Commun.; 13: No. 9, 1289-1292(1 Nov 1973).

Fraunhofer pattern-like behaviors were observed in the critical current versus magnetic field characteristics of super conducting Pb–(20 wt.%) In thin films. The results are discussed in terms of current-phase relation in the type-II superconductor. (auth)

11336 NONLINEAR CONTINUUM THEORY OF THE FLUX-LINE LATTICE IN SUPERCONDUCTORS. Anthony, V. K. H. (Univ., Stuttgart); Seeger, A. Phil. Mag.; 28: No. 5, 1125-1148 (Nov 1973). (In German).

For lattices of straight and parallel flux-lines in superconductors a non-linear, local elasticity theory is established. This theory is capable of describing the magnetic flux distribution, e.g. in the Schubnikow phase of type-II superconductors, for fixed orientation of the flux-lines with respect to the atomic lattice. The theory allows for dislocations in the flux-line lattice. Interaction effects between the flux-line lattice and pinning centres are taken into account by means of volume forces acting on the flux-line lattice. Non-linear, local constitutive equations of the flux-line lattice are established. The terms in these equations associated to pure compression are derived from the reversible magnetization curve. The theory may be applied to both macroscopic and microscopic investigations of the flux distribution. As an example stress-free dislocation structures of the flux-line lattice in type-II superconductors are investigated. (auth)

11337 EFFECT OF HYDROSTATIC PRESSURE ON SUPERCONDUCTING LEAD–INDIUM ALLOYS USING ELECTRON TUNNELING. Hansen, H. H.; Pompi, R. L.; Wu, T. M. (State Univ. of New York, Binghamton). Phys. Rev., B; 8: No. 3, 1042-1054 (1 Aug 1973).

The effect of pressure on the effective phonon spectrum $\alpha(\omega)F(\omega)$, the dimensionless electron–phonon interaction strength λ, and the average electron-phonon coupling function $\langle\alpha^2\rangle$ was determined in the superconducting alloys $Pb_{95}In_5$ and $Pb_{88}In_{12}$. Electron-tunneling measurements at pressures from 0 to 3600 bar provided the energy gap and tunnelling density of states which served as input to McMillan's gap inversion program which calculated $\alpha^2(\omega)F(\omega)$, λ, and $\langle\alpha^2\rangle$. Pressure production was via solid helium which provided nearly hydrostatic pressures. The energy gap decreases and the phonon frequencies increase with increasing pressure. The impurity band undergoes the smallest relative shift with increasing pressure and the transverse peak exhibits the largest shift. $\alpha^2(\omega)F(\omega)$ shifts toward higher frequencies and decreases slightly in amplitude. The net result of all these effects is for a shift of the electron–phonon interaction toward weaker coupling. The best indicators of this trend are the observed decrease of λ and $\langle\alpha^2\rangle$ with increasing pressure. These values are $d\ln\lambda/dP = -7.9\times10^{-6}$ bar^{-1} and $d\ln\langle\alpha^2\rangle/dP = -3.2\times10^{-6}$ bar^{-1} for $Pb_{88}In_{12}$. The values for $Pb_{95}In_5$ are close to these. The pressure dependence of γ, the electronic-specific-heat coefficient, determined from the pressure dependence of the quantity $Z_n(0) = 1 + \lambda$, gives a value close to that of Pb determined from thermal-expansion measurements and from recent theoretical considerations. (37 references, 3 tables, 11 figures) (auth)

11338 FLUX-FLOW PROPERTIES OF A DIRTY TWO-BAND SUPERCONDUCTOR IN THE MIXED STATE NEAR H_{c2}. Tang, I. M. (American Univ., Beirut, Lebanon). Phys. Rev., B; 8: No. 3, 1276-1278(1 Aug 1973).

The transport equations describing the flux-flow states of a dirty two-band superconductor near H_{c2} are obtained by adding the normal-state thermoelectric, thermomagnetic, and galvanomagnetic effects to the electric and heat currents arising from the motion of the two energy gaps. In the limit of high-impurity concentrations, these two gaps merge into a single gap whose behavior is determined by a single set of Landau–Ginzburg equations. The flux-flow properties of the dirty two-band superconductor are obtained by imposing a set of boundary conditions on the transport equations. It is seen that the dirty two-band expression for the Hall angle has a form nearly identical to the usual expression for the Hall angle in a dirty superconductor in the mixed state. It is concluded that the two-band expressions for the flux-flow properties in the dirty transition-metal superconductors predict the same qualititative behavior as the usual one-band expressions. (auth)

Equipment and Devices

Refer also to abstracts 10814, 10816, 10820, and 12367.

11339 (COO-1569-108) HYPERFINE ENHANCED NUCLEAR MAGNETIC COOLING IN $PrCu_6$. Swinehart, R. M.; Weyhmann, W. (Minnesota Univ., Minneapolis (USA). Tate Lab. of Physics). Dec 1973. Contract AT(11-1)-1569. 116p. Dep. NTIS $8.00.

An experimental investigation was carried out on the physical properties of $PrCu_6$ relevant to its use, when adiabatically demagnetized, as a coolant for attaining ultralow temperatures. The crystal structure of $PrCu_6$ results in a singlet ground state for the Pr electron system and an externally applied magnetic field polarizes the two 4f Pr electrons to give an effective enhancement, via the hyperfine interaction, to the magnetic field seen by the Pr nuclear magnetic moment. As determined from magnetic susceptibility measurements, this enhancement factor was found to be 15.0 ± 1.0 in a 0.55-kG applied magnetic field. Starting conditions of 20 kG and approximately 22 mK yielded 3.0 mK for a final field of 0.55 kG. The specific heat of $PrCu_6$ was found to obey an a/T^2 law over the approximate range 6 to 30 mK with $a = 4\times10^{-6}$ J-deg/mole in a 0.55-kG field. At higher and lower temperatures an excess specific heat appears; around 4.5 mK there appears to be a large, very sharp specific heat anomaly. The nuclear magnetic susceptibility shows Curie law behavior down to 10 mK, where the susceptibility begins increasing more rapidly until apparently resuming its higher-temperature behavior below 4 mK. The bulk electronic thermal relaxation time of $PrCu_6$ would seem to go through a peak value of approximately one hour just above 3 mK and decrease to much less than a minute by 8 mK. The above results point to a possible nuclear ordering in the Pr nuclear spin system at approximately 4.5 mK. (19 figures, 52 references) (auth)

11340 (COO-3480-2) [DEVELOPMENT AND USE OF A LIQUID-HELIUM CRYOSTAT]. Final Report, June 15, 1969–June 14, 1972. Coppens, P. (State Univ. of New York, Buffalo (USA)). 1973. Contract AT(11-1)-3480. 37p. Dep. NTIS $4.00.

Under the contract a liquid-helium cryostat has been developed and tested which allows collection of three-dimensional x-ray diffractometer data at liquid-helium temperatures. The design is such that collection of accurate low temperature data is relatively easy compared with other low-temperature techniques. The instrument can be adapted to several commercially available three-circle diffractometers and thereby opens an extensive new field of crystallographic studies. The manufacturer of the instrument (Cryogenics Associates of Indianapolis) has since supplied the cryostat to several crystallographic laboratories in the U. S. and Europe. The instrument has been used for charge density determinations by diffraction methods, and for studies of temperature dependent magnetic behavior in iron complexes. Its potential is being applied in further studies presently sponsored by the National Science Foundation. (auth)

11341 (JPRS-60590) DISCHARGE OF A SUPERCONDUCTING STORAGE DEVICE THROUGH AN INVERTER. Andrianov, V. V.; Zenkevich, V. B.; Popkov, O. V.; Sergeenkov, B. N.; Sukhorukov, A. G.; Sychev, V. V.; Tovma, V. A.; Sheynkman, V. S. Translated from Dokl. Akad. Nauk SSSR; 196: No. 2, 320-323 (1971). 7p. NTIS.

The possibility of using superconducting inductive storage devices with a semiconductor inverter for high efficiency performance is discussed. (auth)

11342 TRANSIENT-RECORDER, CRYOGENIC-FLUX-JUMPS 10 CHANNELS (11 SEP 1972) (ENGINEERING MATERIALS). (California Univ., Livermore (USA). Lawrence Livermore Lab.). (CAPE-2368).

17 Drawings.

Drawings of a ten-channel, variable-threshold, time-sequence recorder that uses TTL are presented. Channel-to-channel time resolution is ~250 nsec, and risetime is ~6 usec, for a 2-V p-p signal. Although the recorder is designed to examine the flux-jump phenomenon in large, superconducting magnets, it has application wherever variable-threshold time-sequencing is required. (auth)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 10241, 11320, 11698, and 12064.

11343 (AWRE-O-40-73) GUIDE TO GALAXY 3*. Part 1. Price, J. A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Nov 1973. 69p. Dep. NTIS (U.S. Sales Only) $5.50. UK £1.50.

GALAXY 3* Part 1 is an IBM program to compute spectrum-weighted, group averaged nuclear cross sections and group-to-group transfer cross sections from the evaluated microscopic cross section data contained in the UKAEA Nuclear Data Library. A description is given of the input and output schemes and operating procedures for the IBM 370/165 together with the structure and functioning of the program and other relevant topics. (auth)

11344 (CEA-CONF-2409) FRENCH ACTIVITIES IN THE FIELD OF NUCLEAR DATA. Ribon, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 9p. (In French). (CONF-730538-5). Dep. NTIS (U.S. Sales Only) $3.00.

From national Soviet conference on neutron physics; Kiev, USSR (28 May 1973).

The organization and the nature of the experimental, compilation, and evaluation activities with respect to nuclear data are briefly summarized. The expression of the needs is made by different mechanisms, well polished for those concerning reactors and still under organization for others. (tr-auth)

11345 (EANDC-92-U) SUMMARY RECORD (TECHNICAL) OF THE SIXTEENTH MEETING OF THE COMMITTEE, PARIS, FRANCE, NOVEMBER 27-DECEMBER 1, 1972. Conde, H. (comp.). (European American Nuclear Data Committee). 1972. 71p. Dep. NTIS (U.S. Sales Only) $5.75.

The scope of the document is indicated by the sections into which it is divided: introductory items, facilities and measurements, measurement reviews and evaluations, nuclear reactor data request lists, other needs for nuclear data, international cooperation in nuclear data measurement and analysis, data indexing and compilation—the data centers, future basis of the committee work, meetings and conferences of interest to the EANDC, special samples, and topical discussion. Highlights of the meeting are summarized in a separate section. A list of EANDC documents issued since the fifteenth EANDC meeting (October 1971), the 1972 report of the EANDC subcommittee on standards and discrepancies, a list of meetings and conferences of interest to the EANDC, and the agenda of the EANDC topical discussion on $\bar{\nu}$ are included in appendices. (RWR)

11346 (JINR-P3-7282) WATER AND ZIRCONIUM HYDRIDE CONVERTERS FOR ULTRACOLD NEUTRONS (UCN). Holding of Neutrons in Copper and Glass Vessels. Groshev, L. V.; Dvorestskii, V. N.; Demidov, A. M.; Lushchikov, V. I.; Nikolaev, S. A.; Panin, Yu. N.; Pokotilovskii, Yu. N.; Strelkov, A. V.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The results of investigation of the yields of UCN from water and zirconium hydride converters are given. The ratio of the UCN yields from the water and zirconium hydride to aluminum is 10:3:1, respectively. The measured time of holding of neutrons in copper vessels is ~30 sec, and in glass vessels is about 105 sec. (5 figures, 2 tables) (auth)

11347 (KFK-1826) SNOW: A TWO-DIMENSIONAL SN-PROGRAM FOR SOLVING THE NEUTRON-TRANSPORT-EQUATION IN RECTANGULAR AND CYLINDER GEOMETRY. Guenther, C.; Kinnebrock, W. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Jul 1973. 153p. (In German). Dep. NTIS (U. S. Sales Only) $9.75.

SNOW is a FORTRAN IV program for solving the two-dimensional multigroup transport equation by the method of discrete ordinates (SN method). (x,y) plane and (r,z) or (r,θ) cylindrical geometries, isotropic and anisotropic scattering, and a lot of other special options are permitted. Three methods of convergence acceleration are incorporated. (auth)

11348 (RCN-196) COMPILATION OF EVALUATED CROSS SECTION DATA USED IN FAST NEUTRON METROLOGY. Zijp, W. L.; Voorbraak, W. P.; Nolthenius, H. J. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Oct 1973. 165p. Dep. NTIS (U. S. Sales Only) $10.25.

A compilation of data describing the cross sections of activation and fission reactions used in neutron metrology work is presented. The energy-dependent cross section data used were taken from the UKDL, the ENDF/B, and the KEDAK data files obtained from the CCDN. Also, some cross section data sets from other sources were considered. This report is an extension of an earlier study published in reports with restricted distribution. For each energy-dependent cross section set a graph is presented, together with the numerical data in a fixed energy group structure, the average cross section values for fission spectra, the effective threshold energy determined with a least-squares method for the fission spectra, and the accompanying effective cross sections. (130 figures, 5 tables, 42 references) (auth)

11349 (RT/FI-(73)16) FOUR ACES: A PROGRAMME FOR PRODUCING GROUP AVERAGED CROSS SECTIONS FROM DIFFERENT FILES. Panini, G. C. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). 28 May 1973. 89p. Dep. NTIS (U.S. Sales Only) $6.50.

The computer code FOUR ACES calculates group-averaged nuclear constants from pointwise and parametric data in the UKNDL, ENDF/B, and KEDAK formats. A maximum of 256 energy groups is accepted with either a built-in or a user-supplied weighting function. Resonance parameters are treated according to the Breit-Wigner (single and multilevel), Adler-Adler, and Reich-Moore formalisms. Numerical Doppler broadening to a given temperature can be applied to the cross sections before the averaging. Several desirable features of FOUR ACES include simplicity of data input, spectrum options, and card image output tape. (auth)

11350 (TKK-F-A-216) OPTIMAL ANGULAR QUADRATURE SETS IN THE DISCRETE S_n APPROXIMATION TO NEUTRON TRANSPORT THEORY. Kalli, H. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). 23 Oct 1973. 15p. Dep. NTIS (U.S. Sales Only) $3.00.

Three different methods for tailoring the quadrature sets are proposed. These methods are illustrated by studying the discrete S_2 approximation in one-dimensional slab geometry, but the applicability in more complicated cases is also discussed. In the case studied the three methods gave rather similar results. The high accuracy obtained by the Gaussian and double Gaussian S_2 sets in certain slab problems is explained. (1 figure, 4 tables) (auth)

11351 (UCID-16395) STATUS REPORT TO USNDC. Anderson, J. D.; Browne, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Nov 1973. Contract W-7405-eng-48. 23p. Dep. NTIS $3.25.

This status report to USNDC by Lawrence Livermore Laboratory contains brief items on the following subjects: standards (2 papers), neutron data applications (4 papers), basic science (3 papers), and controlled thermonuclear research applications (2 papers). (11 figures, 2 tables) (RWR)

For title listings of selected papers see: 11352, 11353, 11392, 11393, 11525, 11539, and 11540.

11352 (UCID-16395, pp 2-3) PULSED SPHERE MEASUREMENTS ON ^{235}U AND ^{239}Pu. Anderson, J. D.; Davis, J. C.; Grimes, S. M.; Haight, R. C.; Komoto, T. T.; Logan, C. M.; McClure, J. W.; Pohl, B. A.; Wong, C. 14 Nov 1973.

In status report to USNDC.

11353 (UCID-16395, p 5) MEASUREMENTS AND CALCULATIONS OF THE NEUTRON SPECTRA FROM CONCRETE BOMBARDED WITH 14-MeV NEUTRONS. Hansen, L. F.; Anderson, J. D.; Kammerdiener, J. L.; Komoto, T.; Logan, C. M.; Wong, C. 14 Nov 1973.

In status report to USNDC.

11354 (UCID-16397) COMPARISON OF EXPERIMENTAL DATA FROM ENERGY-DEPENDENT RESONANCE SELF-SHIELDING FACTORS FOR ^{235}U AND ^{239}Pu WITH CALCULATIONS FROM TART. Bacon, L. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.) 29 Nov 1973. Contract W-7405-eng-48. 26p. Dep. NTIS $3.50.

The self-shielding experiments of Czirr and Bramblett (Nucl. Sci. Eng. 28, 62 (1967); 35, 350 (1969)) were mocked up and calculated with the neutron transport code TART to determine the accuracy of its cross section library. The bremsstrahlung-produced neutron spectrum had been modified to nearly 1/E energy dependence. The fission rate in the detector was measured as a function of shielding thickness (oralloy or Pu) and incident energy. Comparisons between the measured results and TART calculations are shown graphically. It was concluded that TART is not able to compute fission density vs depth correctly for inci-

dent neutron energies at which the cross sections have resonances. This was attributed to the relatively large width of the TART energy groups over which the cross sections are averaged. (22 figures, 4 tables) (RWR)

11355 TWO-DIMENSIONAL TRANSPORT IN A QUARTER SPACE: UNIFORM-SOURCE PROBLEM. Lam, S. K.; Leonard, A. (Stanford Univ., CA). Transp. Theory Statist. Phys.; 3: No. 1, 1-28(1973).

Double Fourier transformation, the Bochner decomposition, and extensive application of contour integration in two complex variables are used to determine the unique solution to the quarter-space problem with a uniform source. Numerical calculations for a moderately absorbing quarter space are presented. Diffusion-theory results are also given for comparison. (13 figures, 1 table) (auth)

11356 MULTIGROUP NEUTRON TRANSPORT IN A FINITE SPHERE. Lorenzutta, S.; Premuda, F. (Comitato Nazionale Energia Nucleare, Bologna). Transp. Theory Statist. Phys.; 3: No. 1, 29-46(1973).

The system of integrodifferential Boltzmann equations that governs the multigroup balance inside a finite sphere is considered. By applying the Fourier transform method, a system of regular Fredholm integral equations is finally obtained. By following the Hilbert–Schmidt theory, a solution for this system is obtained that is strictly related to the transformed total fluxes and, through an angle-dependent factor, also to the transformed angular fluxes. The solution thus obtained is then inverted to give both total and angular fluxes in the original configuration. (auth)

11357 TRANSPORT SOLUTIONS FOR MULTILAYER SLAB-CELL SYSTEMS. Yoshimura, T. (Ship Research Inst., Tokyo); Katsuragi, S.; Suzuki, T. Transp. Theory Statist. Phys.; 3: No. 1, 47-63(1973).

Case's method is applied to one-speed neutron-transport problems in multilayer slab cells. A set of singular integral equations for the eigenfunction-expansion coefficients of the angular neutron flux is derived, and two methods of solution suitable for numerical calculation are presented. In the first method the solution of the Hilbert problem is obtained in the form of power series for a coupling parameter. In the second method the singular integral equations are reduced to a set of Fredholm's integral equations. The numerical results are given. (3 tables) (auth)

11358 ENERGY SPECTRA AND THICKNESS DEPENDENCE OF FAST NEUTRONS TRANSMITTED THROUGH PLANE SCATTERERS. German, U.; Segal, Y.; Notea, A. (Technion–Israel Inst. of Tech., Haifa). J. Nucl. Energy; 27: No. 11, 787-796(Nov 1973).

The energy spectra of neutrons transmitted through iron, lead, and perspex slabs were measured for 0.5, 1.0, 1.5, and 1.8 MeV incident neutron energies, by using a ^{3}He spectrometer. The energy spectra were obtained as a function of the thickness of the scatterer. (auth)

11359 PROPAGATION OF THERMAL NEUTRONS ACROSS AN ABSORPTION DISCONTINUITY IN GRAPHITE. Bhushan, V. (Saldarjang Hospital, New Delhi); Kothari, L. S. J. Nucl. Energy; 27: No. 11, 825-829(Nov 1973).

From first annual conference of Indian Association for Radiation Protection; Bombay, India (12 Apr 1973).

Neutron diffusion across an absorption discontinuity in graphite was considered for natural graphite on one side and Sm poisoned graphite on the other. A plane geometry was taken with the first medium of finite thickness and the second medium is assumed to extend to infinity along the x direction. Neutron spectra and effective neutron temperature are shown at 300°K for three concentrations of Sm, viz. $N_{Sm} = 0.52 \times 10^{18}$ atoms/cm^3, $N_{Sm} = 1.04 \times 10^{18}$ atoms/cm^3, and $N_{Sm} = 2.08 \times 10^{18}$ atoms/cm^3. The results are discussed. (UK)

11360 NEW SPECTRAL REPRESENTATION IN NEUTRON TRANSPORT THEORY. Collatz, S. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 7, 218-221 (Jul 1973).

A new representation of the neutron transport problem for plane geometry is found using a complete set of special spectral functions. The usefulness of the new representation for investigations in neutron transport theory is shown in the plane and time-independent case, and practicable corrections of the neutron diffusion approximation are given. (2 figures) (auth)

11361 GENERALIZED NELKIN'S EXPANSION FOR PLANE LATTICES IN A MULTIGROUP P_N THEORY. van Binnebeek, J. J. (Univ., Brussels). J. Nucl. Energy; 27: No. 11, 769-785(Nov 1973).

The decay λ of a burst of neutrons in a plane lattice with symmetric multilayered cells is computed in a P_N multigroup theory versus the geometrical buckling k. The transport eigenvalue problem is transformed by Vladimirov's symmetric decomposition, and the space variable is eliminated by integration in each layer along the unit cell and by use of Bloch's theorem as boundary condition. A transmission operator for the unit cell generates a generalized eigenvalue problem defining numerically the function $\lambda(k)$. Generalized Nelkin's coefficients are computed for various water–berrylium lattices and compared with those obtained for the volume homogenized lattices. (auth)

11362 TIME DEPENDENT NEUTRON TRANSPORT THEORY FOR HOMOGENEOUS FAST MULTIPLYING SYSTEMS. Grundmann, U. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 2, 52-56(Feb 1973).

For the solution of the time-dependent multigroup transport equation the Laplace transformation is carried out with respect to time. The inhomogeneous part of the integral form of the transport equation in spherical geometry is expanded in terms of the eigenfunctions of the homogeneous equation. By using an expansion in a series of Legendre polynomials the space dependence is treated. In the investigation of pulsed fast multiplying systems the greatest real eigenvalues are considered. The appearance of a pseudofundamental eigenvalue is discussed. (4 figures, 2 tables) (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 11390, 11391, and 11403.

11363 (BMFT-FBK-73-25, pp 33-41) DEPOLARIZATION OF NEUTRONS IN ELASTIC n–p AND n–d SCATTERING. Sep 1973. (In German).

In annual report, 1972.

11364 (JINR-P2-7507) RECOIL AND CHARGE EXCHANGE EFFECTS IN PROTON ELASTIC SCATTERING BY ^{3}He AND ^{4}He NUCLEI. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The recoil effects in the elastic p–^{3}He, p–^{4}He scatterings are considered. They give the additional phase-shifts to the parts of the amplitudes of these processes describing the multiple collisons. That changes strongly the values of the polarizations of protons in the p–^{3}He and p–^{4}He scatterings (T_p = 600 MeV) in the curve minimum and at large momentum transfers. The sensitivity of observables in the elastic p–^{4}He scattering at T_p = 600 MeV to the intermediate charge-exchange effects is also analyzed. (auth)

11365 (KFKI-73-59) KINEMATICALLY COMPLETE MEASUREMENT ON THE D(n,np) REACTION AT $\theta_n = 0°$. Kecskemeti, J.; Czibok, T. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). 1972. 13p. Dep. NTIS (U.S. Sales Only) $3.00.

The differential cross section of the D(n,np) reaction was measured at $\theta_n = 0°$. Due to the special geometry applied the experimental data extend over a large fraction of the phase space, including several final-state-interaction regions as well as regions far from the dominance of the quasi-two-body processes. This offers the possibility of extracting the neutron–neutron scattering parameters and simultaneously getting additional knowledge on the N–N potentials and on three-body forces in the frame of an exact three-body calculation. (4 figures) (auth)

11366 (NP-19873, pp 14-16) ^{2}H(p,2p)n REACTION AT 52 MeV. Seki, S. (Tokyo Univ. of Education); Sanada, J.; Kimura, F.; Furuno, K.; Kuriyama, K.; Tagishi, Y.; Yokomizo, H.; Matsuki, K.; Chiba, M.; Kanai, T.; Worth, D. C.; Koori, N. 1973.

11367 (ORO-4317-32) WHAT CAN WE LEARN FROM THREE-BODY REACTIONS? Technical Report No. 74-037. Brayshaw, D. D. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov. 1973. 12p. Dep. NTIS $3.00.

A new method of analysis is applied to n–d elastic scattering and deuteron breakup in order to test the sensitivity of such reactions to details of the NN force. The results suggest that no off-shell information can be obtained from these processes which is not already implicit in the value of the n–d doublet scattering length. (auth)

11368 ELASTIC SCATTERING OF ^{3}He ON ^{4}He AT MEDIUM ENERGIES. Fetscher, W.; Seibt, E.; Weddigen, C. (Kernforchungszentrum, Karlsruhe, Ger.). Nucl. Phys., A216: No. 1, 47-60(1973).

The differential cross section of the elastic scattering ^{3}He (^{4}He,^{4}He)^{3}He was measured at center of mass energies E_{cm} be-

tween 28 and 44 MeV and in the cm angular range of 20 to 160°. The ^{3}He polarization P at E_{cm} = 42 MeV and θ_{cm} = 132° was determined in a double scattering experiment. The analysis of the cross section data with the optical and the cluster model has been described previously. The phase shifts obtained in the cluster model calculations were used as starting values in a phase shift analysis. The resulting final real phase shifts and elasticity parameters give good fits to the cross section data. At 44 MeV the elasticity parameters show a pronounced odd-even dependence on angular momentum which had been found already in the case of the real phase shifts. The result of the polarization experiment $|P| < 0.22$ is consistent with cluster model predictions. (auth)

11369 MEASUREMENT OF THE TENSOR ANALYSING POWERS T_{20}, T_{21}, AND T_{22} IN d–^{3}H ELASTIC SCATTERING. Debenham, A. A.; Koenig, V.; Grueebler, W.; Schmelzbach, P. A.; Risler, R.; Boerma, D. O. (Technische Hochschule, Zurich). Nucl. Phys., A216: No. 1, 42–46(1973).

The tensor analyzing powers $T_{20}(\theta)$, $T_{21}(\theta)$, and $T_{22}(\theta)$ in the elastic scattering of polarized deuterons on ^{3}H were measured at five energies between 5.0 and 11.5 MeV and in the c.m. angular range from 28.3 to 146.0°. The results were similar to those for d–^{3}He scattering with slight differences in some components between 5.0 and 8.0 MeV. (auth)

11370 NEGATIVE PION CAPTURE ON ^{4}He WITH EMISSION OF NEUTRON–PROTON, NEUTRON–DEUTERON AND NEUTRON–TRITON PAIRS. Barrett, R. J.; McCarthy, J.; Minehart, R. C.; Ziock, K. (Univ. of Virginia, Charlottesville). Nucl. Phys., A216: No. 1, 145-156(1973).

The energies and opening angles for neutron–proton, and neutron–deuteron pairs emitted after π^- capture in ^{4}He were measured. The data are compared to available theoretical calculations. Both energetic protons and deuterons are strongly correlated in direction with an energetic neutron, being emitted at approximately 180° to each other. A strong enhancement at the high energy end of the deuteron spectrum is attributed to a strong final state interaction between the remaining two neutrons. (auth)

11371 MESON EXCHANGE CURRENTS IN DEUTERON ELECTRODISINTEGRATION. Hockert, J. (State Univ. of New York, Stony Brook); Riska, D. O.; Gari, M.; Huffman, A. Nucl. Phys.; A217: No. 1, 14–28(1973).

It is shown that the impulse approximation cross section for backward ed → enp at large momentum transfer near threshold is very much smaller than the empirical data. It is found that the conventional "Jankus theory" is inadequate at large momentum transfer because of the neglect of the $^3D_1$ component of the deuteron state. By taking into account the simplest meson exchange currents of pionic range, the theoretical prediction of the cross section comes into reasonable agreement with the existing data. (9 figures) (auth)

11372 DIFFERENTIAL CROSS SECTIONS FOR NP AND ND ELASTIC SCATTERING NEAR 130 MeV. Howard, V. J. (Queen Mary Coll., London); Edgington, J. A.; Das Gupta, S. S.; Blair, I. M.; Bonner, B. E.; Brady, F. P.; McNaughton, M. W.; Stewart, N. M. Nucl. Phys.; A218: No. 1, 140–150(1974).

The np (nd) elastic scattering cross sections at 25(17) angles in the interval 30°–168° (c.m.) were measured, using a neutron beam with a broad spectrum peaked near 130 MeV. At backward angles the outgoing charged particles from a liquid hydrogen (deuterium) target were detected; at forward angles neutrons scattered from a hydrogenated (deuterated) scintillating target were detected. Cross sections were normalized to the energy dependent solution of the Livermore nucleon–nucleon partial wave analysis, evaluated at 130 MeV. The np measurements represent a marginal improvement on previous work; the nd cross sections show some differences from pd measurements, in agreement with earlier indications at an energy of 152 MeV. (auth)

11373 EXPERIMENT AND THEORY FOR THE ^{2}H(e,p)e'n REACTION. Chong, K. F.; Phenneger, M. C.; Shin, Y. M.; Skopik, D. M.; Tomusiak, E. L. (Univ. of Saskatchewan, Saskatoon). Nucl. Phys.; A218: No. 1, 43-52(1974).

Differential cross sections and angular distributions of protons from the ^{2}H(e,p)e'n reaction were measured at four incident electron energies. The proton angular distributions were measured with the neutron–proton relative energy approximately constant, and an 85° differential cross section was measured as a function of the incident electron energy. The electrodisintegration cross section was calculated using the Hulthén wave function for the ground state with a plane wave for the final state. Reasonable agreement between experiment and theory is found. (auth)

11374 MEASUREMENT OF NEUTRON–PHOTON BREMSSTRAHLUNG NEAR 130 MeV. Edgington, J. A. (Queen Mary Coll., London); Howard, V. J.; Blair, I. M.; Bonner, B. E.; Brady, F. P.; McNaughton, M. W. Nucl. Phys.; A218: No. 1, 151-168 (1974).

The double differential cross section for bremsstrahlung production in neutron–proton collisions near 130 MeV was measured. Outgoing nucleons were detected at eight pairs of angles simultaneously. The cross sections agree with several theoretical predictions for those four angle pairs in which the proton emerged at 20° (θ_p = 20°), but are larger than expected in the four cases that θ_p = 32°. The method of data reduction, and the sources of uncertainty, are discussed in detail. (auth)

11375 TWO-BODY PION PRODUCTION d(p,π^+)t AT 470 AND 590 MeV. Dollhopf, W. (Coll. of William and Mary, Williamsburg, VA); Lunke, C.; Perdrisat, C. F.; Roberts, W. K.; Kitching, P.; Olsen, W. C.; Priest, J. R. Nucl. Phys.; A217: No. 2, 381-399(1973).

The differential cross section for the reaction d(p,π^+)t was measured for c.m. angles between 37 and 160°, at incident proton energies of 470 and 590 MeV. The results are in qualitative agreement with the predictions of a two-nucleon model of the reaction when the D-state contribution is included, except for the existence of a backward peak at 470 MeV. Other models of the reaction are discussed; none of them gives a rationale for the backward peak at 470 MeV. A similar peak is present in older data at 325 MeV. (auth)

11376 MEASUREMENT OF THE PROTON POLARIZATION IN THE ^{3}He(d,p)^{4}He REACTION BETWEEN 2.0 AND 6.0 MeV. Clare, J. F. (Univ. of Auckland, New Zealand). Nucl. Phys.; A217: No. 2, 342-360(1973).

Angular distributions of the polarization of ^{3}He(d,p)^{4}He protons were measured for unpolarized deuterons with laboratory energies of 1.99, 2.81, 3.94 and 6.00 MeV. The polarizations were determined from the left-right asymmetry of elastic scattering through 60° in ^{4}He gas using a vaned polarimeter whose analyzing power was computed by trajectory tracing from the known p-α polarizations. A contour diagram of proton polarization for deuteron energies of 1 to 12 MeV is presented. A Legendre polynomial expansion of four or five terms was fitted to the products $p(\theta)\sigma(\theta)$. The coefficients of the expansions of these and other measurements show resonance-like behavior at ^{5}Li excitations of 20.0 and 20.9 MeV. The vector-polarized beam and polarized-target analyzing powers are compared with the proton polarization. The proton polarizations are in good agreement with the ^{3}He(d,n)^{4}He neutron polarizations when compared at the same entrance-channel energy but disagree when compared at equal exit-channel energies or compound-nucleus excitations. (auth)

11377 DETERMINATION OF THE COUPLING CONSTANTS ^{3}Hdn, ^{3}H^{3}Hπ, AND ^{3}He^{3}Heπ FROM DATA ON THE DIFFERENTIAL CROSS SECTIONS OF n^{3}H AND n^{3}He ELASTIC SCATTERING. Dubnicka, S.; Dumbrais, O. V.; Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A217: No. 3, 535-545(1973).

A determination of the coupling constants ^{3}Hdn, ^{3}H^{3}Hπ and ^{3}He^{3}Heπ from existing differential cross section data for n^{3}H and n^{3}He elastic scattering was carried out. The method is based on the extrapolation of $d\sigma/d\Omega$ to the deuteron and pion poles, exploiting conformal mapping techniques. Calculations result in a value of the ^{3}Hdn coupling constant which is ≈20% smaller than dispersion relation predictions. A comparison of the value obtained with predictions based on nuclear models allows one to discriminate between different potentials. The residue at the pion pole turns out to be too weak and the conclusion is drawn that it is impossible to determine the coupling constants ^{3}H^{3}Hπ and ^{3}He^{3}Heπ on the basis of existing data. (auth)

11378 GROUND-STATE ENERGY AND FORM FACTOR OF THE THREE-NUCLEON SYSTEM. Lovitch, L. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 8: No. 14, 866-872(1 Dec 1973).

The behavior of the binding energy and form factor of the three-nucleon system is examined as the parameters of a phenomenological two-nucleon potential containing a soft core are varied. The binding energies of ^{3}H and ^{3}He and the charge form factor for ^{3}He are calculated. The results indicate that the behavior of the two-nucleon potential at short separations can influence appreciably both the binding energy of the nucleus and the charge form factor. (LBS)

11379 INVESTIGATION OF THE REACTIONS ^{3}He(p,2p)d AND ^{3}He(p,2p)d* AT 45.0 MeV. Jain, M.; Bunker, S. N.; Miller, C. A.; Nelson, J. M.; van Oers, W. T. H. (Univ. of Manitoba, Winnipeg). Lett. Nuovo Cim.; 8: No. 14, 844-848(1 Dec 1973).

The p + ^{3}He reactions at 45 MeV were investigated in a kinematically complete experiment to search for possible excited states of ^{3}He, and to study the reaction mechanism in order to obtain

information about the momentum distribution or wave function of ^{3}He. A detailed comparison made between the measured four-body continua from the ^{3}He(p,2p)pn reaction and phase-space predictions did not exhibit any anomalies which could be interpreted as resonances in ^{5}He. Angular correlations were measured for the ^{3}He(p,2p)d and ^{3}He(p,2p)d* reactions. It is found that the (p,2p) reactions on ^{3}He are fairly well described in the PWIA if a cut-off radius is introduced. (LBS)

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Refer also to abstracts 11201, 11351, 11422, 11429, 11544, and 11577.

11380 (BMFT-FBK-73-25) ANNUAL REPORT, 1972. (Hamburg Univ. (F.R. Germany). 2. Inst. fuer Experimentalphysik). Sep 1973. 130p. (In German). Dep. NTIS (U.S. Sales Only) $8.50.

At the II. Institut fuer Experimentalphysik of the University of Hamburg research is centered on synchrotron radiation spectroscopy, nuclear physics, and elementary particle physics. The synchrotron radiation from the 7.2-GeV electron synchrotron at DESY was used for experiments on solid state, molecular, and atomic spectroscopy. In nuclear physics primarily nuclear moments, hyperfine interactions, and reaction mechanisms were studied. The experiments were done by using radioactive sources, a 3-MeV Van de Graaff generator, and the Hamburg 30-MeV isochronous cyclotron. Elementary particle physics research was carried out in the fields of electromagnetic and strong interactions in close cooperation with DESY and CERN. The investigations were focused on production processes and reaction mechanisms of high-energy photon, electron, and proton interactions. Experiments at the storage rings at DESY and CERN are in preparation. (58 figures, 3 tables, 131 references). (auth)

For title listings of selected papers see: 11195–11197, 11210, 11234, 11363, 11381, 11382, and 11429.

11381 (BMFT-FBK-73-25, pp 42-50) NEUTRON POLARIZATION FROM THE ^{9}Be($\alpha,\vec{n}$)^{12}C REACTION. Sep 1973.

In annual report, 1972.

11382 (BMFT-FBK-73-25, pp 51-55) NEUTRON POLARIZATION FROM THE REACTION ^{14}C(d,n)^{15}N. Sep 1973. (In German).

In annual report, 1972.

11383 (CEA-R-4524) MEASUREMENT OF TOTAL NEUTRON CROSS SECTIONS OF Be, ^{11}B, C, Al, Si, S, Ti, V, Ni, ^{235}U, ^{238}U, ^{239}Pu IN THE ENERGY RANGE 100 keV TO 6 MeV. Cabe, J.; Cance, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92, Montrouge (France)). Nov 1973. 45p. (In French). Dep. NTIS (U.S. Sales Only) $4.25.

Total neutron cross sections in the energy range 100 keV to 6 MeV were measured using transmission method for Be, ^{11}B, C, Al, Si, S, Ti, V, Ni, ^{235}U, ^{238}U, ^{239}Pu with energy spread of 5 to 50 keV and accuracy of 3 and 4% depending on the element and the energy range. The neutrons were obtained by the ^{3}H(p,n)^{3}He reaction, using protons proceeding from the accelerator VAN DE GRAAFF 2 MeV no pulsed and accelerator VAN DE GRAAFF tandem pulsed. (auth)

11384 (ITF-73-91-P) MONOPOLE AND QUADRUPOLE VIBRATIONS OF MAGIC NUCLEI. Filippov, G. F.; Steshenko, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The generalized hyperspherical function method is used to calculate the frequencies of monopole and quadrupole vibrations, as well as some other characteristics of the ^{16}O and ^{40}Ca nuclei for various sets of the central exchange nucleon–nucleon potentials. (auth)

11385 (JINR-P4-7350) FORM FACTORS FOR ELECTRON SCATTERING ON CARBON NUCLEI IN THE α-CLUSTER MODEL WITH PROJECTION. Inopin, E. V.; Luk'yanov, V. K.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 34p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The form factors of the ^{12}C nucleus in the $0^+2^+3^-$ were investigated in the framework of the α-cluster model with projection. Trial functions of the nucleons were selected both with a Gaussian and an exponential asymptotic form. The ambiguity of the model in the description of the observed form factors was recognized. It was shown that, in comparison with the ground states, clustering in the excited states of ^{12}C is intensified. (6 figures, 1 table) (tr-auth)

11386 (LBL-1991) MULTINUCLEON TRANSFER REACTIONS. Scott, D. K. (Oxford Univ. (UK). Nuclear Physics Lab.; California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Aug 1973. Contract W-7405-eng-48. 56p. (CONF-730815-6). Dep. NTIS $5.00.

From international conference on nuclear physics; Munich, F.R. Germany (27 Aug 1973).

The development of higher energies and better resolution in heavy-ion beams has led to a resurgence of interest in transfer reactions at energies well above the Coulomb barrier. Direct reactions with heavy ions are discussed in some detail. Heavy-ion reactions open up the possibility of new methods of spectroscopy, e.g., elastic transfer. Differential cross sections for heavy-ion transfer reactions are often featureless; however, some data show diffractive effects. The high angular momenta associated with recoil effects in heavy-ion reactions can be exploited to perform selective spectroscopy on light nuclei. Although most heavy-ion-transfer data suggest that reactions proceed in a direct fashion, recent experiments indicate the presence of second-order multistep processes. Correlated nucleon transfer and transfer of many nucleons (e.g., (12C,α)) are also being investigated. (20 figures, 3 tables, 93 references) (RWR)

11387 (LBL-2320) TWO-NUCLEON TRANSFER REACTIONS INDUCED BY POLARIZED PROTONS. Macdonald, J. A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 123p. Dep. NTIS $8.25.

Thesis.

($\vec{p}$,t) and ($\vec{p}$, ^{3}He) reactions were induced by polarized protons of 43.8 MeV on ^{16}O, ^{15}N, ^{9}Be, and ^{7}Li, and of 49.6 MeV on ^{13}C targets. The ^{208}Pb($\vec{p}$,t) transitions at $E_{\vec{p}}$ = 40 MeV to four final states in ^{206}Pb were also observed. Relative differential cross sections and analyzing powers were measured for over fifty transitions, of which thirty-six were compared with zero-range DWBA calculations with a spin-orbit potential in the proton channel, and employing wave functions of Cohen and Kurath and of True and Ford. Although generally good results for the differential cross section predictions were obtained, attempts to fit the analyzing powers met with mixed results. In general ($\vec{p}$,t) results were fit better than ($\vec{p}$, ^{3}He), ground state transitions better than those to excited states, and transitions to analog states better than more complex transitions. These conclusions were not altered by including the effects of spin dependence in the two-body interaction or of spin-orbit coupling in the exit channel. It seems doubtful that the discrepancies can be overcome entirely by finite range calculations, though they should be tried, as should attempts to evaluate the importance of second order effects. (auth)

11388 (NP-19873, pp 19-20) OBSERVATION OF POLARIZATION–ASYMMETRY INEQUALITY FOR THE INELASTIC SCATTERING OF 50-MeV PROTONS FROM ^{12}C. Hasegawa, T. (Kyoto Univ.); Kobayashi, S.; Koyama, K.; Matsuoka, N.; Nakamura, M.; Takai, M.; Takeuchi, S.; Tsukamoto, K. 1973.

11389 (NP-19873, pp 20-21) STUDY OF THE ^{18}O(p,t)^{16}O REACTION. Hasegawa, T. (Tokyo Univ.); Kato, S.; Kubono, S.; Takagi, N.; Tanaka, M.; Nagao, M. 1973.

11390 (ORO-1316-168) NUCLEAR PHYSICS PROGRESS REPORT, APRIL 1, 1973–March 31, 1974. Phillips, G. C. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). 1974. Contract AT(40-1)-1316. 23p. Dep. NTIS $3.25.

The research during the year included new experimental and theoretical work on nuclear reaction mechanisms, nuclear polarization, and studies of nuclear structure. The principal equipment employed to carry out this research were the AEC-owned 5.5-MeV and EN Tandem Van de Graaff accelerators and the on-line IBM 1800 Computer System housed in the Rice University-owned T. W. Bonner Nuclear Laboratories. New understanding was obtained during the year on problems of neutron physics, multiparticle breakup, nuclear structure, nuclear theory, and certain nuclear applications to medicine. (auth)

11391 (ORO-1316-169) NUCLEAR STRUCTURE AT INTERMEDIATE ENERGIES PROGRESS REPORT, APRIL 1, 1973–MARCH 31, 1974. Phillips, G. C. (Rice Univ., Houston, Tex. (USA). Bonner Nuclear Labs.). 1974. Contract AT(40-1)-1316. 17p. Dep. NTIS $3.00.

During the year 1973 the program goals of carrying out experimental and theoretical studies in intermediate energy physics were continued. Work at the Space Radiation Effects Laboratory on small-angle pion Coulomb multiple scattering from nuclei was completed, and the small-angle Coulomb–nuclear interference studies and total cross sections were continued. Experiments on p–d breakup were started and, in addition to observing quasi-free nucleon–nucleon scattering, a strongly enhanced neutron–proton final state interaction was observed at 585 MeV for the first time. In July 1973 the outfitting of the Rice-owned portable laboratory was completed, including operation of the AEC-owned PDP-11 on-

line computer system, and the laboratory was moved to Los Alamos, New Mexico (LAMPF). In the fall of 1973 the group aided the LAMPF staff in tuning the P^3 pion channel. Principal collaborators in all this work were the University of Houston group. (auth)

11392 (UCID-16395, pp 4-5) NEUTRON SPECTRA FROM Ni BOMBARDED WITH 14-MeV NEUTRONS. Hansen, L. F.; Anderson, J. D.; Grimes, S. M.; Kammerdiener, J. L.; Komoto, T.; Logan, C. M. 14 Nov 1973.

In status report to USNDC.

11393 (UCID-16395, p 7) STUDY OF THE $^{11}B(p,\alpha)^8Be^* \rightarrow 2\alpha$ RESONANT REACTION. Proctor, I. D.; Lutz, H. F.; Bartolini, W. 14 Nov 1973.

In status report to USNDC.

11394 DIRECT LIFETIME MEASUREMENT OF THE 6.05 MeV O^+ LEVEL IN ^{16}O. Birk, M.; Sokolowski, J. S.; Wolfson, Y. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys., A216: No. 1, 217-220(1973).

The reaction $^{19}F(p,\alpha)^{16}O^*$ was used to populate levels in ^{16}O. Delayed coincidence measurements of α-τ and α-γ gave a value of 96 ± 7 ps for the mean life of the 6.05 MeV 0^+ level in ^{16}O. (auth)

11395 $^{10}B(\alpha,n)^{13}N$, ^{13}N CROSS SECTION FOR α-ENERGIES FROM 1.0 TO 5 MeV. Van der Zwan, L.; Geiger, K. W. (National Research Council of Canada, Ottawa). Nucl. Phys., A216: No. 1, 188-198(1973).

The three neutron groups, populating the ground state, the 2.366 MeV state and the 3.51, 3.55 MeV doublet of ^{13}N were studied. Differential cross section measurements between E_α = 1.0 and 5.0 MeV at 0, 90, and 160° showed fifteen resonances of which nine had not been seen before in this reaction. Angular distributions were taken at six α-energies. These confirmed the $J^\pi = 3^-$ assignment of the 12.690 level in ^{14}N and permitted a tentative assignment of $J^\pi = 3^-$ to the 13.166 MeV level. Compound nucleus formation involving overlap of several resonances appears dominant, except for the neutron group to the doublet in ^{13}N which shows evidence for a direct reaction mechanism. (auth)

11396 COMPARATIVE ANALYSIS OF PION–NUCLEUS ELASTIC AND INELASTIC SCATTERING. Germond, J. F.; Amiet, J. P. (Univ., Neuchatel, Switzerland). Nucl. Phys., A216: No. 1, 157-165(1973).

Pion elastic scattering cross sections around the (3,3) resonance were computed for three different nuclei using standard high energy approximations. The results given by the different approximations are found to be very close to each other. Using the eikonal DWIA the excitations of the low-lying 2^+ (4.4 MeV) and 3^- (9.6 MeV) states of ^{12}C were computed for three different nuclear models. The present accuracy of the experimental data does not allow definite statements about the quality of these models. No adjustable parameter was used in the calculations. (auth)

11397 HARTREE–FOCK CALCULATIONS FOR A = 4n s–d SHELL NUCLEI USING A DENSITY-DEPENDENT EFFECTIVE INTERACTION. Curry, P. D.; Sprung, D. W. L. (McMaster Univ., Hamilton, Ont.). Nucl. Phys., A216: No. 1, 125-144(1973).

The effective force G-0 of Spring and Banerjee which gives a good representation of properties of spherical nuclei is found to give a good representation for size, binding energy and deformation of light A = 4n nuclei. Density contour plots are highly suggestive of an α-particle type cluster in these nuclei. A bubble configuration is found for ^{36}Ar, which appears to be an α-cluster hole removed from ^{40}Ca. (auth)

11398 CALCULATION OF ANGULAR AND ENERGY DISTRIBUTIONS FOR NUCLEAR RECOIL REACTIONS $^{19}F(\gamma,n)^{18}F$ ACCORDING TO A QUASI-DEUTERON MODEL. Denisov, F. P.; Duisebaev, A. D. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 75-76(1972). (In Russian).

The angular and energy distributions of the recoil nucleus ^{18}F formed in the reaction $^{19}F(\gamma,n)^{18}F$ under the influence of bremsstrahlung with a maximum energy of 260 MeV was calculated on the basis of a quasi-deuteron model for the absorption of high energy quanta by nuclei. Possible sources of discrepancy between experimental data and the results of the calculations were explored. (tr-auth)

11399 RELATIONSHIP BETWEEN CHARGE AND MASS MULTIPOLES OF LIGHT NUCLEI. Inopin, E. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 28-31(1972). (In Russian).

It is shown that for nuclear transitions between states of null isospin there is a simple relation which connects the transition probability (B(E2)) and the matrix elements of mass multipole operators. The latter are determined from experiments on inelastic diffraction scattering. A comparison is made with experimental data for the nuclei ^{12}C, ^{20}Ne, and ^{24}Mg. (tr-auth)

11400 SPECTROSCOPIC FACTORS FROM RADIATIVE CAPTURE REACTIONS. Rolfs, C. (Univ. of Toronto). Nucl. Phys.; A217: No. 1, 29-70(1973).

The nonresonant γ-ray yield in radiative capture reactions is known to arise from a direct-capture process. Previous studies of this process in several light nuclei have been mainly concerned with astrophysical aspects. The present work demonstrates that this process can be, in addition, a useful tool in nuclear spectroscopy. The process selects states in the final nucleus which have parentage in the ground state of the target nucleus. The observed γ-ray angular distributions are characterized by the orbital angular momenta of the final states; and the observed total cross sections reveal, when compared with model calculations, the spectroscopic factors for the final states. These features are similar to results derived from stripping reactions. The direct capture mechanism (electromagnetic interaction) is amenable to exact calculations in contrast to the more complex stripping reaction mechanism. The results for proton capture by ^{16}O and ^{17}O targets are compared with available stripping data as well as shell-model calculations. (17 figures, 3 tables) (auth)

11401 DIRECT DETERMINATION OF THE ENERGY RELEASE FOR THE 3α BREAKUP OF THE SECOND-EXCITED STATE OF ^{12}C. Barnes, C. A.; Nichols, D. B. (California Inst. of Tech., Pasadena). Nucl. Phys.; A217: No. 1, 125-140(1973).

The energy difference between the second-excited state of ^{12}C and three α particles was determined by implanting ^{12}B ions within a silicon surface-barrier detector and observing the pulses from the 3α decay of the second-excited state of ^{12}C, formed in ≈1.5% of the ^{12}B decays. The result obtained, Q = 379.6 ± 2.0 keV, is in good agreement with that obtained by measuring the excitation energy of the ^{12}C second excited state and then subtracting three times the mass excess of an α particle. The combined results from the present work and three recent excitation measurements are Q = 380.1 ± 1.1 keV. (5 figures, 3 tables) (auth)

11402 ELASTIC AND INELASTIC DEUTERON SCATTERING ON ^9Be, ^{11}B, ^{12}C, AND ITS THEORETICAL INTERPRETATION. Ozen, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Istanbul Univ. Fen Fak. Mecm., Seri C; 35: No. 1-4, 17-48(1970). (In German).

The angular distributions of the elastic and inelastic deuteron scattering on ^9Be, ^{11}B, and ^{12}C were measured with the Heidelberg MP tandem Van de Graaff accelerator. At a constantly maintained relative energy of 14.5 MeV of the bombarding projectile–target system, the laboratory incident energies were 17.748, 17.158, and 16.939 MeV. The particle separation was done by the electronic pulse multiplication method. The deflected 11.8-MeV deuteron beam of the Heidelberg cyclotron was used for measurement of the target thickness. The shields of the counter telescope were measured with the 6.05-MeV α particles of a ^{212}Pb source. The elastic scattering was analyzed with the optical model with use of various parameter terms. The optical parameters determined agree partially with the parameter terms found at 11.8 MeV. The variation of the parameters from nucleus to nucleus is ascribed to the fraction of the compound elastic scattering. Some angulation distributions of the inelastically scattered deuterons can be described with the DWBA method according to the collective model and the microscopic theory. The β_L values and the strength of the nucleon–nucleon interaction respectively determined therefrom agree well with the values determined by other methods. An attempt was made to describe the strongly excited states of ^{11}B with the excited core model and with the Nilsson model. For the Kurath theory, in which the excited states of the nuclei of the $1p_{\frac{1}{2}}$ shell have a pure 1p-shell structure, the $1p_{\frac{1}{2}} \rightarrow 1p_{\frac{3}{2}}$ transition calculations were made for one excited state of the ^9Be, ^{11}Be, and ^{12}C nuclei. (13 figures, 8 tables) (tr-auth)

11403 PHOTONEUTRON PRODUCTION CROSS-SECTION OF BERYLLIUM AND DEUTERIUM AT A NUMBER OF GAMMA ENERGIES BELOW 3 MeV. Vesely, F.; Bensch, F. (Oesterreichische Hochschule, Vienna). J. Nucl. Energy; 27: No. 11, 828(Nov 1973).

By using the experimental yield value of photoneutron sources, which is defined as the neutron emission (sec^{-1}) of 1 g of a target material located at a distance of 1 cm from a 1 Ci point gamma source, calculations were made of (γ,n) cross sections of ^9Be and $^2H_2$. Results are tabulated. (UK)

11404 EFFECT OF HIGH-LYING CONFIGURATIONS ON THE ODD-PARITY SPECTRUM OF ^{16}O. Mavromatis, H. A.; Singh, B. (American Univ., Beirut, Lebanon). Nucl. Phys.; A217: No. 2, 238-244(1973).

The effect on the $1\hbar\omega$ odd-parity spectrum of ^{16}O of high-lying

configurations is studied by including all states at $3\hbar\omega$, and all states at $3\hbar\omega$ and $5\hbar\omega$, in second-order perturbation theory. It is found that inclusion of the $3\hbar\omega$ states results in a lowering of the spectrum by about 2 to 3 MeV when the single-particle and single-hole energies are also calculated. By contrast the $5\hbar\omega$ states further affect the energy levels by ½ MeV or less. When the above calculations are repeated with experimental single-particle and single-hole energies no overall improvement in the spectrum is obtained. Adding a hard-core potential (whose inclusion does not alter the two-body phase shifts) to the Sussex interaction lowers the $1\hbar\omega$ spectrum by about 1 MeV, without including higher configurations. (auth)

11405 MICROSCOPIC DESCRIPTION OF SCATTERING OF LOW-ENERGY NEUTRONS BY ^{12}C. II. Mori, A. (Tokyo Inst. of Tech.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 1960-1973 (Jun 1973).

The low energy neutron scattering on ^{12}C is treated by the generalized R-matrix theory. The microscopic wave function is assumed for the intrinsic state of ^{12}C and realistic effective two-body potentials are used for the interaction between the incident nucleon and nucleons of the target. The antisymmetrization between the incident nucleon and the nucleons of the target is found to be very important. The relation between the antisymmetrization and the renormalization of the interaction strength needed in the microscopic coupled channel calculation is discussed. Without the antisymmetrization or the renormalization, it is impossible to reproduce the resonances at reasonable position by the present calculation. The calculated widths of the resonances, however, disagree with the observed ones even if the antisymmetrization is taken into account. (auth)

11406 GIANT MAGNETIC DIPOLE ANALOG EXCITATIONS BY THE ALLOWED MUON CAPTURE IN 1p-SHELL NUCLEI. Mukhopadhyay, N. C. (Univ. of Maryland, College Park). Phys. Lett.; 45B: No. 4, 309-312(6 Aug 1973).

The distributions of the allowed muon capture strengths in 1p-shell nuclei are shown to exhibit a tendency to concentrate in a few low-lying daughter states. These strong excitations are analogs of the giant magnetic dipole transitions, predicted by Kurath, and observed in inelastic electron scattering. Similar excitations are expected in 1S radiative pion capture and low-energy charged pion photoproduction processes. (auth)

11407 STRUCTURE STUDY OF ^{11}B FROM THE SCATTERING OF NEUTRONS FROM ^{10}B. Hausladen, S. L.; Nelson, C. E.; Lane, R. O. (Ohio Univ., Athens). Nucl. Phys.; A217: No. 3, 563-572 (1973).

Differential cross sections for neutrons scattered from ^{10}B were measured for 1.5 MeV < E_n < 4.4 MeV. These results and elastic scattering and polarization data at lower energies together with data from the reactions $^{10}B(n,\alpha_0)^7Li$ and $^{10}B(n,\alpha_1)^7Li$ (0.48 MeV) were simultaneously fitted using a two-level, four-channel R-matrix formalism with a nondiagonal background R^0 matrix. The level parameters obtained from the R-matrix fitting of these data for states in ^{11}B with excitation energies 11.5 MeV < E_x < 15.5 MeV are consistent with other reactions such as $^{10}B(n,n'\gamma)^{10}B$ (0.717), $^7Li(\alpha,n_0)^{10}B$ and $^7Li(\alpha,n_1)^{10}B$ (0.717) which lead to states in ^{11}B. (auth)

11408 DIFFERENTIAL CROSS SECTION AND POLARIZATION FOR 2.63 MeV NEUTRONS SCATTERED FROM ^{12}C. Knox, H. D.; Cox, J. M.; Finlay, R. W.; Lane, R. O. (Ohio Univ., Athens). Nucl. Phys.; A217: No. 3, 611-627(1973).

The differential cross section and polarization of 2.63 MeV neutrons scattered from ^{12}C were measured at eight angles between 17 and 118° in the laboratory system. By simultaneously fitting the cross section and polarization data, a set of scattering phase shifts was obtained. The values of the resulting d-wave phase shifts were larger than those of other existing sets of phase shifts in the energy region. A subsequent R-function analysis, reflecting these larger d-wave phase shifts, gave excellent fits to other experimental data below 3 MeV neutron energy region. The influence of narrow states at 7.50 and 7.55 MeV excitation energy in ^{13}C is discussed. (auth)

11409 STRUCTURE STUDY OF ^{12}B FROM THE ELASTIC SCATTERING OF NEUTRONS FROM ^{11}B. Nelson, C. E.; Hausladen, S. L.; Lane, R. O. (Ohio Univ., Athens). Nucl. Phys.; A217: No. 3, 546-562(1973).

Differential cross sections for neutrons scattered from ^{11}B were measured for 2.2 MeV < E_n < 4.5 MeV. The differential cross section $\sigma(\theta)$ is fitted reasonably well by R-matrix parameters for broad states in ^{12}B with assignments 1^- and $(1)^+$ at excitation energies E_x = 5.8 and 6.8 MeV respectively. The broad 1^- state has not been previously observed and is believed to be the 1^- member of the $1p_{\frac{3}{2}}^{-1}\,1d_{\frac{5}{2}}$ particle-hole multiplet predicted to exist by earlier shell model calculations. Its existence completes the identification of all of the levels of this multiplet (3^-, 2^-, 4^-, 1^-). The broad $(1)^+$ level at E_x = 6.8 MeV has not been previously observed. States at excitation energies E_x = 5.61, 5.73, and 6.6 MeV were assigned spins and parities of 3^+, 3^- and $(1)^+$ respectively. These states had previously been assigned spins of 2, 3 and ≥1 respectively. Work on T = 1 states in ^{12}C* was compared with the present work. (auth)

11410 ^{19}F + p REACTION AT E_p = 669 keV RESONANCE. I. Fujishiro, M.; Hiraoka, E.; Furuta, J. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 79-85(Mar 1973).

$^{19}F(p,\gamma)^{20}Ne$ and $^{19}F(p,\alpha\gamma)^{16}O$ reactions at the 669 keV resonance were investigated through γ-ray spectroscopy with a 40 cm³ Ge(Li)-detector. Previous spectra found in literature were well resolved, and a precise analysis of the data was performed. The spectroscopic comparison and the Doppler broadening of the 7.12-MeV γ-ray resulting from the $^{19}F(p,\alpha\gamma)^{16}O$ reaction are reported. (auth)

11411 ANALYSIS OF ALPHA-DECAY WIDTHS FOR MOLECULAR VIEWPOINTS IN LIGHT NUCLEI. Horiuchi, H. (Kyoto Univ.); Suzuki, Y. Progr. Theor. Phys. (Kyoto); 49: No. 6, 1974-2004(Jun 1973).

Alpha-decay widths of SU_3, deformed oscillator and cluster model wave functions are calculated quantitatively for the ground band levels of ^{8}Be and the first $K = 0^-$ band levels of ^{20}Ne. Tails of the reduced width amplitudes of these model wave functions are amended by two methods, of which one is to connect smoothly the inner original reduced width amplitude with the resonance tail given by the release energy of α particle, and the other is to apply the Green's-function method developed by Kawai and Yazaki for the calculation of the radial form factor for the stripping or pick up reactions. From comparisons of the calculated results with experiments it is concluded that the SU_3 model is insufficient to reproduce large α-decay widths. It is further shown that the deformed oscillator model is also considered to be inappropriate for the general explanation of the (rotational) levels with large cluster widths. From these consequences on SU_3 and deformed oscillator models and by the numerical confirmation that the cluster model wave functions can naturally reproduce the experiments consistently with the variational energy calculations, the importance of the molecular viewpoint in light nuclei is emphasized. (auth)

11412 $^7Li(p,n)^7Be$ REACTION WITH POLARIZED PROTONS FROM THE THRESHOLD TO 3.0 MeV. Rohrer, U. (Univ. of Basel); Brown, L. Nucl. Phys.; A217: No. 3, 525-534(1973).

A polarized beam was used to measure angular distributions of the proton analyzing power of the $^7Li(p,n)^7Be$ reaction at 11 energies from 2.05 to 3.00 MeV. The analyzing power is generally large and positive. The analyzing power can be fitted with associated Legendre polynomials. The coefficient of P_1^1 rises rapidly from threshold to a maximum near the 3^+ state at 2.25 MeV from which it drops to a minimum at 2.42 MeV, whence it gently rises to 3.00 MeV; the coefficient of P_2^1 has small values that increase with energy. The data were measured typically to an accuracy of 0.02 with a target 20 keV thick at 2 MeV bombarding energy. Polarization contour maps are given. Comparison of these analyzing power measurements with previous data for the neutron polarization induced with unpolarized protons shows equality at some energies and slightly higher values at others. (auth)

11413 RESONANCE SCATTERING OF BREMSSTRAHLUNG BY ^{6}Li, ^{11}B, AND ^{27}Al. Saito, T. (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 35: No. 1, 1-7(Jul 1973).

The bremsstrahlung beam from a 5-MeV electron linear accelerator was used to excite and study low lying levels in ^{6}Li, ^{11}B and ^{27}Al. A self-absorption method was used to find the widths Γ of these levels. The following level widths are obtained: $\Gamma = (6.5^{+1.1}_{-1.4})$ eV for the 3.56-MeV level in ^{6}Li; $\Gamma = (0.23 \pm 0.09)$ eV for the 2.12-MeV level, and $\Gamma = (0.53 \pm 0.21)$ eV for the 4.44-MeV level in ^{11}B. For the 2.98-MeV level in ^{27}Al, the level width is found to be $\Gamma = (0.10 \pm 0.04)$ eV assuming that the lower energy member of the doublet at 3 MeV is excited. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 11348, 11383, 11397, 11399, 11411, 11432, and 11483.

11414 (AECL-4595) PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1973. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1973. 87p. (PR-P-98). Dep. NTIS (U.S. Sales Only) $6.50. AECL $2.00.

This report, administrative in nature, contains sections prepared by the nuclear physics, neutron and solid state physics, theoretical physics, and mathematics and computation branches. Areas of special concentration include tandem operation, nuclear physics research with heavy ions, solid state studies with neutron scattering and positron annihilation, development of solid state detectors, and applied studies and computation. (RWR)

For title listings of selected papers see: 11415, 11504, 11505, and 11515.

11415 (AECL-4595, pp 14-16) T = 1 STATES IN ^{20}F AND ^{20}Ne. Forster, J. S.; Ball, G. C.; Davies, W. G.; Leslie, J. R.; McLatchie, W.; Millington, G. F. Jul 1973.

11416 (BARC-692, pp 11-16) PROPERTIES OF STATES IN ^{33}S. Balakrishnan, M.; Mehta, M. K.; Kailas, S.; Kanetkar, L. J.; Divatia, A. S. 1973.

11417 (BARC-694) ANNUAL REPORT OF THE NUCLEAR PHYSICS DIVISION FOR THE PERIOD ENDING DECEMBER 1972. Ramamurthy, V. S.; Roy, A. P. (eds.). (Bhabha Atomic Research Centre, Bombay (India)). 1973. 202p. Dep. NTIS (U. S. Sales Only) $12.25.

The first section of this report contains fairly complete articles on the following subjects: PURNIMA, role of filter detector spectrometer in neutron spectrometry, magnetic materials and neutron diffraction, and nuclear physics research with 5.5-MeV van de Graaff accelerator. Then brief reports are presented on research in the following areas: nuclear physics (nuclear reaction and spectroscopic studies, fission physics studies), solid state physics (x-ray crystallography, neutron crystallography, neutron diffraction studies of magnetic materials, neutron inelastic scattering and dynamics of condensed media, Moessbauer spectra and hyperfine fields), reactor neutron physics, and experimental techniques and instrumentation. Teaching and training activities, publications, and a list of the Nuclear Physics Division staff are also included. (RWR)

For title listings of selected papers see: 10290, 11418, 11419, 11428, 11532, 11557, 11558, and 11904–11906.

11418 (BARC-694, pp 37-41) PROPERTIES OF STATES IN ^{33}S. Balakrishnan, M.; Mehta, M. K.; Kailas, S.; Kanetkar, L. J.; Divatia, A. S. 1973.

11419 (BARC-694, pp 45-49) OPTICAL MODEL ANALYSIS OF ELASTIC SCATTERING OF ^{28}Si FROM ^{28}Si. Saini, S.; Mehta, M. K. 1973.

11420 (JINR-P15-7401) STUDY OF THE ^{22}Ne(^{3}He,p)^{24}Na, ^{22}Ne(^{3}He,α)^{21}Ne REACTION. Osetinskii, G. M.; Son Van Nahm; Faruk, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The ^{22}Ne(^{3}He,p)^{24}Na, ^{22}Ne(^{3}He,α)^{21}Na reaction was studied in the energy range 2.9 ± 4.1 MeV. At the angles of 45, 90, 135° the excitation functions were measured for the P_0, $P_{1,2}$, P_3, $P_{4,5}$; α_0, α_1, α_2 states of final nuclei ^{24}Na, ^{21}Ne, respectively. The angular distributions are measured for the $P_{1,2}$, P_3, $P_{4,5}$, α_0, α_1, α_2 groups of the reactions considered. The mean value of the total width of the compound ^{25}Mg nucleus levels is determined for the excitation energy region 22.65 – 23.7 MeV. (auth)

11421 (ORNL-TM-4389) GAMMA-RAY PRODUCTION FROM NEUTRON INTERACTIONS WITH SILICON FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 130p. Dep. NTIS $8.50.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with silicon were obtained for neutron energies between 1.0 and 20 MeV. The cross-section values were obtained by using a NaI spectrometer. These data consist of (a) the production of gamma rays by neutron reactions with values of $d^2\sigma/d\omega dE$ for θ_γ = 125 and 90° and for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \approx 9$ MeV and with neutron energy intervals varying from 0.25 MeV for En = 1.0 to 2.0 MeV to 3 MeV for En = 14 to 20 MeV, and (b) values of $d\sigma/d\omega$ for En = 1.78 MeV for θ_γ = 125° and for En between threshold and 9.6 MeV. (57 figures, 61 tables) (auth)

11422 LIFETIME MEASUREMENTS IN ^{29}Al. Beck, F. A.; Byrski, T.; Costa, G.; Engelstein, P. (Univ., Strasbourg). Nucl. Phys.; A218: No. 1, 213-220(1974).

The lifetimes of the first six excited states of ^{29}Al have been measured by the DSA method with two different reactions, ^{26}Mg(α,p)^{29}Al and ^{27}Al(t,p)^{29}Al. The recoil distance method was also used to remeasure the mean lifetime of the first excited state, leading to a value τ_m = 6.5 ± 0.5 ps. Experimental results are compared with shell model calculations. (auth)

11423 ELASTIC AND INELASTIC SCATTERING OF 30.5 MeV PROTONS BY ^{24}Mg. Eenmaa, J. (Univ. of Southern California, Los Angeles); Cole, R. K.; Waddell, C. N.; Sandhu, H. S.; Dittman, R. R. Nucl. Phys.; A218: No. 1, 125-139(1974).

Measurements of the differential cross sections for the elastic scattering of 30.5 MeV protons by ^{24}Mg and for the inelastic scattering to the 1,37, sum of 4.12 and 4.23, 5.22 and 6.0 MeV states are reported. Optical model fits to the elastic data, a distorted wave calculation for the first excited state, and coupled channel calculations are also presented. (auth)

11424 ^{24}Mg(^{7}Li,t)^{28}Si REACTION AND CHANGE IN DEFORMATION SIGN IN THE MIDDLE OF THE s–d SHELL. Rosner, B. (Univ. of Pennsylvania, Philadelphia); Wittner, K.; Bethge, K.; Tserruya, I. Nucl. Phys.; A218: No. 1, 1-12(1974).

The ^{24}Mg(^{7}Li,t)^{28}Si reaction was studied at bombarding energies of 12, 16, 19, and 20 MeV. Angular distributions of the outgoing tritons were analyzed using FRDWBA calculations. The most interesting results concern the weakness of the transitions to all known members of the $K^\pi = 0^+$ ground state band. On the other hand the 0^+ state at 6.69 MeV is strongly populated. The results are discussed in terms of the SU(3) model. The hindrance in the transitions to the g.s. band of ^{28}Si may be due to the change of the deformation sign from prolate to oblate between ^{24}Mg and ^{28}Si. The 0^+ state at 6.69 MeV in ^{28}Si is then the band head of the prolate band in this nucleus. (auth)

11425 DEFORMATIONS OF GROUND BANDS IN ^{20}Ne, ^{24}Mg, AND ^{28}Si. II. Horikawa, Y. (Juntendo Univ., Tokyo); Nakada, A.; Torizuka, Y. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2005-2020(Jun 1973).

Deformed charge distributions of ^{20}Ne and ^{28}Si are determined from electron scattering within a framework of the rotational model. Deformed Fermi distributions are assumed for the intrinsic charge distributions of these nuclei and the DWBA analysis is carried out for the ground-band transitions. The results are compared with (p,p') and (α,α') results. The validity of the scattering analysis using the rotational model is also examined to some extent. For this purpose, previous rotational model results for ^{20}Ne, ^{24}Mg and ^{28}Si with Nilsson-like intrinsic states are compared with the results using angular momentum projection. (auth)

11426 NUMBER-PROJECTED HFB THEORY IN THE NUCLEAR 2s–1d SHELL: COMPARISON WITH EXACT SHELL-MODEL RESULTS. MacDonald, N.; Morrison, I.; Watt, A. (Univ. of Glasgow). Nucl. Phys.; A217: No. 3, 429-437(1973).

Within the framework of Hartree–Fock–Bogoliubov theory a method is described for number projection before variation. The method is applied to some even nuclei with neutron excess, on the assumption that for such nuclei n-n and p-p pairing dominate. For each case level spectra are produced by angular momentum projection after variation. The basis used is the 2s-1d shell, and within that basis there is good agreement with exact shell model spectra for the nuclei ^{24}Ne, ^{26}Mg and ^{32}Ar. This agreement extends to states not in the ground state band. (auth)

11427 PHOTOPROTONS IN GIANT RESONANCE REGION FOR ^{31}P. Tsubota, H. (Tohoku Univ., Sendai); Kawamura, N.; Oikawa, S.; Sugawara, M.; Shoda, K. J. Phys. Soc. Jap.; 35: No. 2, 330-336(Aug 1973).

The energy spectra of photoprotons were measured for ^{31}P with the electrodisintegration at 90°. The differential cross sections of the (γ,p_0) and the (γ,p_1) reactions are derived from them. Many fine structures are found in the results. The most of the structures found in the spectra can be explained by the (γ,p_0) component. The result of the (γ,p_0) cross section is compared with the ^{32}S$(\gamma,p_0)^{31}$P cross section. Both the results agree well with each other in the gross structures, but the absolute value of the ^{31}P$(\gamma,p_0)^{30}$Si differential cross section is much smaller than that of the ^{32}S$(\gamma,p_0)^{31}$P reaction. The (γ,p_1) differential cross section seems to show some gross structures though the errors of the result are rather large. Discussions are made with a single particle excitation process of the valence nucleon. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 10801, 11348, 11383, 11384, 11386, 11390, 11397, 11462, 11483, 11486, 11510, 11562, and 11577.

11428 (BARC-694, pp 42-45) (p,n) REACTION CROSS-SECTION MEASUREMENTS ON ^{50}Ti, ^{54}Cr, AND ^{59}Co. Chintalapudi,

S. N.; Kailas, S.; Ganguly, N. K.; Gupta, S. K.; Kanetkar, L. J.; Kerekatte, S. S.; Mehta, M. K. 1973.

11429 (BMFT-FBK-73-25, pp 56-79) (α,n) REACTIONS ON ^{40}Ca, ^{44}Ca, ^{40}Ar, ^{16}O, AND ^{14}N. Sep 1973. (In German).
In annual report, 1972.

11430 (CEA-CONF-2408) ESTIMATION OF THE CAPTURE CROSS SECTION OF IRON. Le Coq, G.; Ribon, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 5p. (In French). (CONF-730538-4). Dep. NTIS (U.S. Sales Only) $3.00.
From National Soviet conference on neutron physics; Kiev, USSR (28 May 1973).
The capture cross sections of structural materials are very important for reactor physics. The resonant structure should be described as well as possible because it has a direct effect on the self-shielding and, therefore, the effective cross section. About 250 resonances were introduced for natural iron, determined from experiments or from uncertain parameters. The capture cross sections are tabulated for ^{56}Fe, ^{54}Fe, ^{57}Fe, and natural iron. (1 table) (tr-auth)

11431 (ITF-73-97-P) FOUR-PARTICLE MODEL OF ^{16}O AND α-^{12}C SCATTERING. Kharchenko, V. F.; Kuz'michev, V. E. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
^{16}O and α-particle scattering by ^{12}C are considered in the framework of a four-α-particle model on the basis of the integral equations of motion for four particles which have been formulated earlier. The two α-particle interaction is described by means of a separable potential. The first excited 0$^+$-state of the four α-particles is obtained with energy somewhat lower than the threshold α + ^{12}C. The amplitude of the purely nuclear α-^{12}C scattering at zero energy was calculated. (auth)

11432 (NP-19873, pp 23-25) NATURAL PARITY STATES OF ^{38}Ar FROM THE ^{40}Ar(p,t)^{38}Ar REACTION. Suehiro, T. (Tohoku Inst. of Tech., Sendai); Miura, K.; Shoji, T.; Hiratate, Y.; Ohnuma, H. 1973.

11433 (NP-19873, pp 25-27) (p,d) AND (p,t) REACTIONS ON ^{40}Ca AT 52 MeV. Kubono, S. (Tokyo Univ.); Kato, S.; Ohnuma, H.; Yasue, M.; Nagao, M.; Tsukamoto, K.; Kuramasu, R. 1973.

11434 (NP-19873, pp 27-29) ELASTIC AND INELASTIC SCATTERING OF 82 MeV ^{3}He ON ^{58}Ni. Sato, K. (Tokyo Univ.); Tanabe, T.; Sekiguchi, M.; Koike, M.; Orihara, H.; Hasegawa, T.; Ogawa, H.; Yamada, T.; Furuya, M.; Yamazaki, T.; Fujita, M.; Sakurada, Y.; Homma, T.; Hirao, Y. 1973.

11435 (NP-19873, pp 29-32) ^{58}Ni(^{3}He,α)^{57}Ni REACTION AT 82 MeV. Sekiguchi, M. (Tokyo Univ.); Tanabe, T.; Sato, K.; Koike, M.; Hasegawa, T.; Hirao, Y.; Orihara, H. 1973.

11436 (UCID-15937(Rev.1), pp 17; 18-19) PHOTONEUTRON CROSS SECTIONS FOR ^{59}Ni AND ^{60}Ni. Fultz, S. C.; Alvarez, R. A.; Meyer, P.; Berman, B. L. 10 Nov 1971.
Status report to NCSAC.

11437 HALF-LIFE OF ^{40}Ca(3.35). Bartle, C. M.; Quin, P. A. (Univ. of Wisconsin, Madison). Nucl. Phys., A216: No. 1, 90-96 (1973).
The half-life of the first excited state of ^{40}Ca, measured with the ^{40}Ca(n,n')^{40}Ca reaction, is $T_{\frac{1}{2}}$ = 2.14 ± 0.10 ns, in good agreement with previous data. The calculated monopole matrix element corresponding to this half-life is 2.6 ± 0.1 fm^2. (auth)

11438 SPIN-PARITY ASSIGNMENTS OF THE ^{49}Sc LEVELS FROM THE GAMMA-DECAY OF THE $^{3}/_{2}^{-}$ ISOBARIC ANALOGUE STATE IN ^{49}Sc. Adachi, M.; Taketani, H. (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 35: No. 2, 317-324(Aug 1973).
Gamma ray spectra and the angular distributions for the 1975 keV resonance, which is the strongest of the seven resonances associated with the ^{49}Ca ground state analogue in the ^{48}Ca(p,γ) reaction, have been measured with Ge(Li) detectors. Gamma-gamma coincidence spectra have also been measured to confirm the decay scheme. To identify the transitions between the low-lying states, gamma rays from the ^{48}Ca(d,nγ)^{49}Sc reaction have been measured at E_d = 3.0 MeV. Spins and parities of some of the levels in ^{49}Sc as well as the tentative gamma decay scheme have been determined from these data with the aid of previous reaction data. (auth)

11439 M1 TRANSITION STRENGTH FROM THE $^{3}/_{2}^{-}$ ISOBARIC STATE IN ^{49}Sc. Adachi, M.; Taketani, H. (Tokyo Inst. of Tech.). J. Phys. Soc. Jap.; 35: No. 2, 325-329(Aug 1973).
Gamma rays from the strongest five of seven resonances associated with the ^{49}Ca ground-state analogue in the reaction ^{48}Ca(p,γ)^{49}Sc have been measured. The B(M1) for the gamma decay of the isobaric analogue state (IAS) to the 3032 keV anti-isobaric analogue state (AIAS) is found to be 1.2 × 10^{-2} W.U., which is hindered by a factor of ~ 1.7 × 10^{-2} with respect to a simple shell model prediction. This hindrance has been found to be due to the fact that several levels at around 6.5 MeV, which presumably arise from the core-polarization configuration, absorb most of the M1 strength. The correspondence between the strength of the Gamow-Teller (GT) beta transition from the ^{49}Ca g.s. to the 3082 keV state in ^{49}Sc and the strength of the σ-part of the M1 transition from the IAS to the AIAS is discussed. (auth)

11440 FIVE-PARTICLE-ONE-HOLE STATES IN ^{44}Sc. Benson, H. G. (Univ. of Manchester, Eng.); Johnstone, I. P.; Castel, B. Nucl. Phys.; A217: No. 1, 189-196(1973).
Odd-parity levels in ^{44}Sc are investigated by coupling both proton and neutron $d_{\frac{3}{2}}$ holes to states of mass-45 nuclei by using projected Hartree-Fock wave functions. It is found that most particle-hole interactions taken from the literature cannot account for the observed low excitation energy of neutron hole states. Energy levels, neutron spectroscopic factors, and γ-transition rates are calculated using the Erné interaction. (1 figure, 3 tables) (auth)

11441 PROPERTIES OF NUCLEAR LEVELS EXCITED BY NEUTRON CAPTURE γ-RAYS FROM COBALT. Tenenbaum, J.; Moreh, R.; Nof, A. (Negev Nuclear Research Centre, Beer Sheva, Israel). Nucl. Phys.; A218: No. 1, 95-103(1974).
Neutron capture γ-rays from cobalt were used to photoexcite nuclear levels in the 5-8 MeV region. The decay properties of the 7491 keV level in ^{55}Mn and the 6877 keV level in ^{142}Nd were studied in detail. Total and partial radiative widths of nuclear levels in several isotopes were determined using nuclear self-absorption, temperature variation, and absolute scattering cross section measurements. The total radiative widths were found to be of the same magnitude as those of unbound levels populated in neutron resonances. The spins and parities of some resonance levels were determined by carrying out angular distribution and polarization measurements, respectively. (auth)

11442 DEFORMATION OF ^{46,48,50}Ti FROM 104 MeV α-PARTICLE SCATTERING. Rebel, H.; Hauser, G.; Schweimer, G. W.; Nowicki, G.; Wiesner, W.; Hartmann, D. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Phys.; A218: No. 1, 13-42(1974).
Differential cross sections were measured for the elastic and inelastic scattering of 104 MeV α-particles from ^{46,48,49}Ti. The experimental results are analyzed in terms of coupled channels on the basis of various limiting models of the collective behavior of these nuclei: symmetric rotator (^{46}Ti), asymmetric rotator (^{48}Ti) and anharmonic vibrator (^{50}Ti). The analysis uses both the usual extended optical model and a semimicroscopic folding model. Prolate-oblate and γ-asymmetry effects are studied and confirm prolate deformation of ^{46}Ti and ^{48}Ti. Hexadecapole transitions ($0^+ \rightarrow 4_1^+$) are found. (auth)

11443 INELASTIC SCATTERING STUDIES ON ^{53}Cr. Peterson, R. J.; Stoub, E. W. (Univ. of Colorado, Boulder). Nucl. Phys.; A218: No. 1, 109-124(1974).
The inelastic scattering of protons, deuterons, τ and α from ^{50}Cr was studied. Spins, parities and transition strengths were inferred for many states. The 1.89 MeV 4$^+$ state is excited by a double-excitation process, but more weakly than expected for a two-phonon state. A weak 5$^-$ state is found at 4.37 MeV, and a 5$^+$ state is inferred at 3.792 MeV. (auth)

11444 FIT OF THE ANALOG RESONANCES IN ^{46}Ti. Lukasiak, A.; Zych, W. (Inst. of Nuclear Research, Warsaw). Acta Microbiol. Pol., Ser.; B4: No. 4, 489-494(1973).
Calculations concerning some of the resonances in the excitation curve ^{45}Sc(p,p) in the energy range of incident protons E_p = 1.6 to 1.8 MeV are presented. Four resonances are considered as analog ones in the compound nucleus ^{46}Ti. (2 figures, 2 tables) (auth)

11445 MAGNETIC SUB-STATE POPULATION CROSS SECTIONS IN INELASTIC ALPHA-NUCLEUS SCATTERING. Glanz, P. K.; Rawitscher, G. H. (Univ. of Connecticut, Storrs). Nucl. Phys.; A217: No. 2, 299-316(1973).
Properties of the sub-state population cross sections σ_M for inleastic α-nucleus scattering are explored within the deformed collective nuclear model. The interference between the nuclear and Coulomb parts of the inelastic transition potential is calculated with the DWBA. The effect on the M = -2 sub-state cross section is substantially more pronounced than that for the usual inelastic differential cross section $\Sigma_M\sigma_M$. The effect of reorientation terms is calculated by means of a coupled channel formalism for small values of the quadrupole deformation parameter β_2. It is found to shift the angular position of the

minima of the σ_M relative to the DWBA result, in a way which depends on the sign of β_2. A spin orbit potential has only a small effect on the σ_M. The calculations refer to 15-MeV α-particles incident on a nucleus of the size and charge of Ca. (auth)

11446 ELECTROMAGNETIC TRANSITIONS IN ^{42}Ti. Cox, A. J.; Caraca, J. M. G.; Schlenk, B.; Gill, R. D.; Rose, H. J. (Oxford Univ.). Nucl. Phys.; A217: No. 2, 400-409(1973).

Levels in ^{42}Ti up to 4 MeV were investigated using the ^{40}Ca(^{3}He,n)^{42}Ti reaction and a neutron time-of-flight method. Using the DSA method, lifetimes of 750 ± 300, >200, 350 ± 250, >2000 and <250 fs were measured for levels at E_x = 1.56, 1.83, 2.40, 2.68 and 3.74 MeV respectively. The level at E_x = 3043.0 ± 1.5 keV is tentatively identified as the 6+ member of the $(f_{\frac{7}{2}})^2$ configuration, and its mean life was measured as 26 ± 5 ns by a direct timing method. Using isospin formalism, transition strengths are compared with theoretical and experimental values for ^{42}Ca and ^{42}Sc. (auth)

11447 LEVEL DENSITY PARAMETERS FOR THE BACK-SHIFTED FERMI GAS MODEL IN THE MASS RANGE 40 < A < 250. Dilg, W. (Univ., Munich); Schantl, W.; Vonach, H.; Uhl, M. Nucl. Phys.; A217: No. 2, 269-298(1973).

The parameters a and Δ for the Fermi gas model with fictive ground state are determined for about 220 nuclei from experimental level densities at low excitation energy and at the neutron binding energy. In agreement with previous results it is found that for most nuclei the fictive ground state is back-shifted relative to the conventionally shifted ground state as determined by the pairing energy. Shell effects are evident at the mass numbers 90, 140 and 208 for both the level density parameter a and the back-shift. A comparison is given with previous results and different experimental data on level densities. (auth)

11448 CRITICAL EVALUATIONS OF DECAY PROPERTIES AND COMPILATIONS OF OTHER USEFUL DATA OF FREQUENTLY USED RADIONUCLIDES. Grinberg, B. (CEN, Saclay, France); Brethon, J. P.; Lagoutine, F.; Le Gallic, Y.; Legrand, J.; Wapstra, A. H.; Weiss, H. M.; Bambynek, E.; de Roost, E.; Hansen, H. H.; Spernol, A. At. Energy Rev.; 11: No. 3, 515-690(1973).

The General Introduction gives an outline of the work that has been embarked upon by the authors with the main aim of providing critical evaluations of the decay properties of a wide range of important radionuclides. Certain definitions and rules are given. The first three evaluations to be completed, those for cobalt-58, cobalt-60, and chromium-51, follow. They are based on an exhaustive compilation from publications up to and including 1972, and the "best" values deduced are given. In addition, most of the other useful data — atomic and nuclear — have been extensively compiled and tabulated. (4 figures, 87 tables) (auth)

11449 STUDY OF ^{50}V USING THE DIRECT REACTIONS ^{49}Ti(^{3}He,d) AND ^{51}V(d,t). Sourkes, A.; Ohnuma, H.; Hintz, N. M. (Univ. of Minnesota, Minneapolis). Nucl. Phys.; A217: No. 3, 438-458(1973). (COO-1265-129).

Energy levels in ^{50}V up to 4.3 MeV were studied using the ^{49}Ti(^{3}He,d)^{50}V and ^{51}V(d,t)^{50}V reactions with ^{3}He particles of 22 MeV and deuterons of 19.5 MeV incident energy. More than eighty levels are seen, with angular distributions taken for forty-one levels in the (^{3}He,d) reaction and for the ten lowest levels in the (d,t) reaction. The angular distributions are compared with the distorted-wave Born approximation (DWBA) to extract the l-values of the transferred nucleons and obtain the spectroscopic strengths. In the stripping reaction, a small amount of l = 0 and l = 2 strength is seen, indicating the presence of s and d proton holes in the g.s. of ^{49}Ti. The results are compared with a recent shell-model calculation based on an $(f_{\frac{7}{2}})^n$ configuration, and show qualitative agreement. (auth)

11450 STUDY OF THE ISOBARIC ANALOGUE STATES IN ^{56}Fe FROM (p,γ) AND (p,n) REACTIONS IN ^{55}Mn. Ahmed, N.; Rahman, M. A.; Awal, M. A.; Rahman, M.; Katun, S. (Atomic Energy Centre, Dacca, Bangladesh). J. Phys. Soc. Jap.; 35: No. 2, 348-356(Aug 1973).

Isobaric analogue states of ^{56}Mn in the compound nucleus ^{56}Fe are investigated with (p,γ) and (p,n) reactions up to a proton energy of ~3 MeV, and the Coulomb displacement energy derived from the measurement is (8.641 ± 0.047) MeV. Some of the analogue resonances display a fine structure superimposed on a gross structure and are analyzed using the resonance formalism of Robson. (auth)

11451 ELECTROMAGNETIC DECAY OF FRAGMENTED ANALOGUE STATES IN ^{56}Mn AND ^{59}Co. Peters, W. C. Durham, NC; Duke Univ. (1973). 149p. University Microfilms Order No. 73-19,501.

Thesis (Ph. D.).

The inelastic and γ decay of the fragmented analogs of the ground states of ^{55}Cr and ^{59}Fe was studied. By using the TUNL high-resolution electrostatic analyzer–homogenizer system, the ^{54}Cr(p,γ) excitation function from 1.98 to 2.02 MeV and the ^{58}Fe(p,γ) excitation function from 2.15 to 2.30 MeV were measured with a 7.6 cm by 7.6 cm NaI(Tl) detector. By using an 80-cm^3 Ge(Li) detector at 55° with respect to the incident beam, absolute inelastic proton and γ decay widths were measured for 10 resonances in the vicinity of the ground-state analog in ^{55}Mn and for 22 resonances in the vicinity of the ground-state analog in ^{59}Co. Eight of the resonances in ^{55}Mn and ten of the resonances in ^{59}Co were identified as fragments of the respective ground state analog. The M1 strengths of both of these transitions, assuming no E2 admixtures, were 0.05 Weisskopf units. Comparisons of the γ decay of the ground-state analog with the β decay of the ground states of ^{55}Cr and ^{59}Fe were made. In general, the widths corresponding to the β decay were weaker than the experimentally determined γ decay widths. The inelastic proton and γ decay widths were examined for possible correlations with the enhanced elastic channel widths. Positive correlations which were significant at a confidence level of greater than 95% were measured. The correlations of channel widths for resonances in ^{59}Co not associated with the ground-state analog were consistent with purely statistical behavior. (RWR)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 11297, 11348, 11383, 11428, 11436, 11447, 11448, 11451, and 11562.

11452 (BARC-692, pp 20-24) CONVERSION ELECTRON STUDIES OF THE EXCITED STATES IN ^{74}As FROM THE ^{74}Ge(p,n)^{74}As REACTION. Agrawal, Y. K.; Bharathi, S. M.; Bhattacherjee, S. K.; Lal, B.; Sahai, B. 1973.

11453 (BMFT-FBK-73-22, pp 18-23) IDENTIFICATION OF SHORT-LIVED NEUTRON-RICH GERMANIUM NUCLIDES. Kratz, J. V. Aug 1973. (In German).

In annual report, 1972.

11454 (BMFT-FBK-73-22, pp 61-67) DECAY OF ARSENIC-84 AND -85. Franz, H.; Kratz, J. V. Aug 1973. (In German).

In annual report, 1972.

11455 (N-73-27600) SCATTERING OF 42-MeV ALPHA PARTICLES FROM COPPER-65. Stewart, W. M.; Seth, K. K. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Jul 1973. 29p. (NASA-TN-D-7354; E-7404). NTIS $3.00.

Beams of 42-MeV alpha particles were elastically and inelastically scattered from Cu-65 in an attempt to excite states which may be described in terms of an excited core model. Angular distributions were measured for 17 excited states. Seven of the excited states had angular distributions similar to a core quadrupole excitation and eight of the excited states had angular distributions similar to a core octupole excitation. The excited state at 2.858 MeV had an angular distribution which suggests that it may have results from the particle coupling to a two-phonon core state. An extended particle-core coupling calculation was performed and the predicted energy levels and reduced transition probabilities compared to the experimental data. The low lying levels are described quite well and the wave functions of these states explain the large spectroscopic factors measured in stripping reactions. For Cu-65 the coupling of the particle to the core is no larger weak as in the simpler model, and configuration mixing results. (auth)

11456 (NP-19873, pp 34-36) LIFETIME AND FT-VALUE OF ^{62}Ga SUPERALLOWED β-DECAY. Chiba, R. (Tokyo Inst. of Tech.); Numao, T.; Shibazaki, S.; Toyama, H.; Yamada, S.; Kotajima, K.; Itagaki, S.; Iwasaki, S. 1973.

11457 (NP-19873, pp 36-38) (p,t) REACTION ON EVEN ISOTOPES OF GERMANIUM. Ishizaki, Y. (Tokyo Univ.); Orihara, H.; Kato, K.; Kokame, J.; Pingel, K.; Suehiro, T.; Kanazawa, M.; Kasagi, J.; Sagi, Y.; Nonaka, I.; Ogata, H. 1973.

11458 (NP-19873, pp 38-41) IN-BEAM γ-RAY STUDY OF ^{74}Se, ^{78,80}Kr AND ^{84}Sr. Yoshikawa, N. (Tokyo Univ.); Numao, T.; Kawakami, H.; Oya, S.; Shida, Y.; Sakai, M. 1973.

11459 ^{76}Se(d,t) REACTION AND A CORIOLIS COUPLING THEORY OF ANOMALOUS STATES IN $1g_{\frac{9}{2}}$ NUCLEI. Sanderson,

N. E. (McMaster Univ., Hamilton, Ont.). Nucl. Phys.; A216: No. 1, 173-187(1973).

The ^{76}Se(d,t)^{75}Se reaction was studied at bombarding energies of 18 to 19 MeV using a magnetic spectrograph. Differential cross sections for levels up to 1200 keV of excitation were observed and analyzed using the DWBA to obtain l-values and spectroscopic factors. A Coriolis coupling calculation with a pairing residual interaction and the inclusion of effects due to blocking was undertaken. The model can account for the occurrence and behavior of the "anomalous" positive parity states which occur in $1g_{9/2}$ shell nuclei. More specifically, for ^{75}Se the model gives reasonable agreement with both the observed spacing of the positive parity levels and the measured spectroscopic factors. (auth)

11460 ELASTIC SCATTERING OF ELECTRONS FROM THE N = 50 ISOTONES: ^{88}Sr, ^{89}Y, ^{90}Zr, AND ^{92}Mo. Singhal, R. P.; Brain, S. W.; Curran, C. S.; Drake, T. E.; Gillespie, W. A.; Johnston, A.; Lees, E. W. (Univ. of Glasgow). Nucl. Phys., A216: No. 1, 29-41(1973).

Elastic electron scattering from ^{88}Sr, ^{89}Y, ^{90}Zr, and ^{92}Mo was measured in the momentum transfer range from 0.25 fm^{-1} to 1.15 fm^{-1}. The difference charge density distributions are compared with the predictions of the independent-particle model. An estimate of the model-dependence of the difference density distribution is made. The data are found to be most sensitive to regions of the charge distribution from 3.5 fm to 4.5 fm. (auth)

11461 BEST VALUE FOR THE HALF-LIFE OF ^{64}Cu. Dema, I.; Harbottle, G. (Brookhaven National Lab., Upton, NY). Radiochem. Radioanal. Lett.; 15: No. 4-5, 261-265(20 Nov 1973).

If one considers the overall importance of the radioisotope ^{64}Cu in the world today, taking into account its measurement in activation analysis studies in forensics (gunshot residues, etc.), pollution studies, soil chemistry, biology, and medicine, it is surprising that the half-life is not more accurately known. However, on the basis of the results reported here, combined with those of several other authors recently reported, it was possible to establish a definitive half-life of 12.700 ± 0.002 hr for ^{64}Cu. (1 table) (auth)

11462 COMPARISON OF EXPERIMENTAL LEVEL DENSITIES AND SPIN CUTOFF FACTORS WITH MICROSCOPIC THEORY FOR NUCLEI NEAR A = 60. Behkami, A. N.; Huizenga, J. R. (Univ. of Rochester, NY). Nucl. Phys., A217: No. 1, 78-92(1973).

The experimental nuclear level densities and spin cutoff factors for ^{55}Mn, ^{56}Fe, ^{59}Co, ^{60}Ni, ^{62}Ni, ^{63}Cu, and ^{65}Cu are compared with a microscopic theory which includes the nuclear pairing interaction. Single-particle levels of Seeger and Nix give quite similar results in this A-region, and both sets of single-particle levels give results which agree well with experiment. The values of ρ(U) and σ^2(U) depend on the structure of the single-particle levels, and the effects of this structure are illustrated and discussed. (9 figures, 1 table) (auth)

11463 GAMMA-RAY ENERGIES OF ^{85}Se AND ^{86}Se. Tamai, T.; Matsushita, R.; Takada, J.; Kiso, Y. (Kyoto Univ., Osaka). Inorg. Nucl. Chem. Lett.; 9: No. 11, 1145-1152(Nov 1973).

The aim of the study described was to separate Se from other fission products rapidly by paper electrophoresis, and to measure the unknown γ-ray energies of the short-lived Se nuclides and their relative intensities. Details are given of the experimental procedure, and results are shown tabulated. (UK)

11464 g-FACTOR OF THE 264 keV LEVEL IN ^{77}As. Chopra, R. C.; Tandon, P. N. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; A217: No. 1, 177-181(1973).

The g factor of the 264-keV ($\frac{5}{2}^-$) level in ^{77}As was measured to be g = 0.30 ± 0.03 by using the perturbed angular correlation technique. This value is in good agreement with the g factor of the corresponding level in ^{75}As. The results suggest this state to be of single-particle nature. (2 figures, 1 table) (auth)

11465 DYNAMIC DEFORMABILITY IN AVERAGE AND HEAVY SPHERICAL NUCLEI. Zhivopistsev, F. A.; Lukashev, A. V.; Shitikova, K. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1537-1542(Jul 1973). (In Russian).

The photoabsorption cross sections for ^{60}Ni, ^{90}Zr, and ^{208}Pb were calculated on the particle hole basis and on the expanded basis (ph, 2p2h). The calculations were made both with and without consideration of the dynamic deformability. The results were compared with experimental values. (J.S.R.)

11466 B(E2↑) AND R_{tr} OF 2_1^+ STATES IN ^{90}Zr AND ^{60}Ni. Singhal, R. P.; Brain, S. W.; Gillespie, W. A.; Johnston, A.; Lees, E. W.; Slight, A. G. (Univ. of Glasgow). Nucl. Phys.; A218: No. 1, 189-200(1974).

The ground state transition probabilities for the 2_1^+ states in ^{90}Zr and ^{60}Ni as determined by resonance fluorescence and reorientation effect methods are used as constraints to deduce transition densities from inelastic electron scattering data. The (e,e′) cross sections for the ^{90}Zr, 2_1^+ state at 2.186 MeV were measured at the Kelvin Laboratory, while for the 2_1^+ state at 1.333 MeV in ^{60}Ni, the existing (e,e′) data of Yale and Sendai were used. The discrepancy between the model independent (e,e′) result of Yale for ^{90}Zr and the (γ,γ') measurement is explained. The importance of an accurate knowledge of the ground state charge distribution for analysis of (e,e′) data is emphasized. For ^{90}Zr, the B(E2↑) is 674 ± 60 $e^2 \cdot fm^4$ and R_{tr} is 5.74 ± 0.11 fm. For the 1.333 MeV state in ^{60}Ni, these values are 918 ± 26 $e^2 \cdot fm^4$ and 5.33 ± 0.03 fm respectively. auth

11467 LIFETIMES OF SOME EXCITED STATES IN ^{64}Ni, ^{66}Zn, AND ^{68}ZN. Ivascu, M. (Inst. of Atomic Physics, Bucharest); Popescu, D.; Dragulescu, E.; Avrigeanu, V.; Besliu, C.; Martalogu, N. Nucl. Phys.; A218: No. 1, 104-108(1974).

Mean lives and excitation energies of the lowest levels in ^{64}Ni, ^{66}Zn, and ^{68}Zn were measured with the aid of the (α,$\alpha'\gamma$) and (α,pγ) reactions. The γ-rays were detected in coincidence with the outgoing particles. The following mean lives were determined from DSA measurements: 400 ± 150 fs for the level at E_x = 1.35 MeV in ^{64}Ni; 270 ± 100, 210 ± 110, 330 ± 200, 80 ± 70 fs for the levels at E_x = 1.87, 2.45, 2.83, 2.94 MeV in ^{66}Zn, and 1300 ± 300, > 160, 600 ± 200 fs for the levels at E_x = 1.08, 1.89, and 2.76 MeV in ^{68}Zn, respectively. (auth)

11468 PAIRING VIBRATIONAL STATES AND THE GENERATOR COORDINATE METHOD. Faessler, A. (Kernforschungsanlage, Juelich, Ger.); Gruemmer, F.; Plastino, A.; Krmpotic, F. Nucl. Phys.; A217: No. 2, 420-428(1973).

The pairing vibrational states and the two-neutron transfer cross sections between these states are calculated in Ni, Sn and Pb isotopes by the generator coordinate method (GCM). The particle number fluctuation of the BCS functions is handled by projecting in a good approximation on sharp particle numbers. The results agree quite well with the experimental data. (auth)

11469 g FACTOR OF THE 8^+ STATE IN ^{86}Sr. Hashimoto, O. (Tokyo Univ.); Nomura, T.; Yamazaki, T.; Miyano, K.; Ishihara, M. J. Phys. Soc. Jap.; 35: No. 2, 337-340(Aug 1973).

The g factor of the 0.46 μsec 8^+ state in ^{86}Sr was measured by the time-differential perturbed-angular-distribution method with a pulsed beam of 51-MeV protons. The result, g = −0.241 ± 0.015, shows that the additivity relation between the $(\nu g_{9/2}^{-2})$ 8^+ state in ^{86}Sr and the $(\nu g_{9/2}^{-1})$ $\frac{9}{2}^+$ state in ^{87}Sr holds well. (auth)

11470 LEVEL STRUCTURE OF ^{69}Ge. Isoya, A.; Kuroyanagi, T.; Nakajima, Y.; Maki, T.; Nakashima, T. (Kyushu Univ., Fukuoka). J. Phys. Soc. Jap.; 35: No. 2, 341-347(Aug 1973).

The level structure of ^{69}Ge was investigated by observing both de-excitation gamma rays and conversion electrons following the ^{69}Ga(p,n)^{69}Ge reaction at the proton energies between 3.4 and 5.0 MeV. By the analysis of the measured excitation functions of de-excitation gamma rays, twenty-two excited levels of ^{69}Ge were found up to 1.8 MeV in the excitation energy. From the branching ratios of the gamma rays and the conversion coefficients, multipolarities of some of the transitions and spins of five low lying levels were determined. (auth)

11471 CAPTURE CROSS SECTIONS OF INTERMEDIATE NEUTRONS. Sriramachandra Murty, M.; Siddappa, K.; Rama Rao, J. (Andhra Univ., Waltair, India). J. Phys. Soc. Jap.; 35: No. 1, 8-11 (Jul 1973).

Radiative neutron capture cross sections for the isotopes ^{59}Co, ^{68}Zn, ^{86}Sr, ^{87}Rb, ^{96}Ru, ^{98}Mo, ^{100}Mo, ^{102}Ru, ^{104}Ru, ^{113}In, ^{115}In, ^{122}Sn and ^{133}Cs were remeasured at the neutron energy 24 ± 5 keV in view of the wide discrepancies in their values as reported in literature. The activation method and 4π geometry absolute gamma counting technique were used to obtain the cross sections. By making a critical comparison of the present results with the earlier experimental values on the one hand and with semi-theoretical estimates on the other, an attempt is made to resolve the discrepancies. (auth)

11472 AXIALLY-SYMMETRIC AND GAMMA-UNSTABLE DEFORMATION IN NUCLEI. Tanaka, Y. (Tokyo Inst. of Tech.); Tomoda, T. Progr. Theor. Phys. (Kyoto); 50: No. 1, 121-136(Jul 1973).

In addition to the rare earth nuclei, there appear band-like structures in many regions of even-even nuclei whose neutrons are rich or deficient. These band structures are named quasi-ground, quasi-β and quasi-γ bands as counterparts of these collective states in the well-deformed region. Nuclei having the quasi-ground band are thought to be in transition regions from spherical to deformed and the low-lying quasi-β or quasi-γ band indicates the softness against the β or γ vibration of these nuclei. A method is proposed in order to predict whether a nucleus is

preferable to be axially symmetric or γ-unstable if it is deformed. This method consists of introducing an idea of preferred shapes of the proton and neutron systems in each case. By the preferred shape we mean the preferred direction of deformation that the system should have inherently. It can be predicted from the preferred shapes of protons and neutrons whether the deformation of the nucleus is axially symmetric or γ-unstable. This method is applied to the lighter Ge, Se, Kr and Sr isotopes, the heavier Zr, Mo and Ru isotopes and the lighter Xe, Ba and Ce isotopes and its prediction is compared with the potential energy surfaces of these nuclei calculated within a framework of the time dependent Hartree–Bogoliubov theory with the pairing plus quadrupole force. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 11167, 11297, 11345, 11348, 11386, 11441, 11447, 11460, 11465, 11466, 11468, 11471, 11472, 11510, and 11562.

11473 (BMFT-FBK-73-22) ANNUAL REPORT, 1972. Weber, M. (comp.). (Mainz Univ. (F. R. Germany). Inst. fuer Kernchemie). Aug 1973. 174p. (In German). Dep. NTIS (U. S. Sales Only) $10.75.

The report is composed of the following parts: A) Performance of the Mainz TRIGA reactor and the mass separator of the Gesellschaft fuer Schwerionenforschung, Darmstadt, B) Rapid chemical separations and detection of short-lived nuclides. Wet chemical procedures: Isolation and detection of short-lived nuclides of mass numbers 100 to 112, separation and identification of short-lived neutron-rich Ge and Nb nuclides, isolation of short-lived isotopes of Sr, Ba, Y and Pd, solvent extraction of Mo. Dry chemical procedures: Volatilization of fission products from fluoride-containing solid targets, rapid reactions in the gas phase, reaction of hot iodine atoms in ethylene, C) Nuclear spectroscopy. Nuclear isomeric states of ^{82}As and ^{152}Pm, decay of ^{84,85}As, ^{91}Sr, ^{105}Tc, ^{110}Rh, ^{128}Sn, ^{157}Sm, ^{173}Er, ^{176}Tm and ^{189}W, γ-ray spectra of short-lived atoms of cerium, detection of ^{236}Th, study of the decay of $^{73-76}$Br, $^{73-77}$Kr, ^{73,74}Zn and neutron-rich alkali metals after mass separation, D) Nuclear fission yields. Fission yields of short-lived halogen isotopes, charge distribution in the chain 132, yields of short-lived cerium isotopes, E) Superheavy elements. Group separation of superheavy elements, excitation functions in the bombardment of uranium with heavy ions, F) Activation analysis. Determination of platinum in boron-containing glasses, G) Publications. (49 figures, 15 tables, 141 references) (auth)

For title listings of selected papers see: 9726, 9854–9858, 9960, 9961, 11453, 11454, 11474–11480, 11506, 11507, 11533, and 11534.

11474 (BMFT-FBK-73-22, pp 9-14) SEPARATION AND IDENTIFICATION OF SHORT-LIVED NUCLIDES IN THE MASS REGION A = 100 TO 112 FROM FISSION OF CALIFORNIUM-249. Trautmann, N. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.); Kaffrell, N.; Ahrens, H.; Dittner, P. F. Aug 1973. (In German).
In annual report, 1972.

11475 (BMFT-FBK-73-22, pp 23-26) SEPARATION OF SHORT-LIVED PALLADIUM ISOTOPES FROM FISSION PRODUCTS. Bruechle, W. Aug 1973. (In German).
In annual report, 1972.

11476 (BMFT-FBK-73-22, pp 67-73) DECAY OF STRONTIUM-95. Grimm, W.; Herzog, W. Aug 1973. (In German).
In annual report, 1972.

11477 (BMFT-FBK-73-22, pp 73-80) DECAY OF TECHNETIUM-105. Suemmerer, K.; Dreisigacker, E.; Kaffrell, N.; Trautmann, N. Aug 1973. (In German).
In annual report, 1972.

11478 (BMFT-FBK-73-22, pp 81-85) DECAY OF 27-s RHODIUM-110. Franz, G. Aug 1973. (In German).
In annual report, 1972.

11479 (BMFT-FBK-73-22, pp 86-89) 60-MIN TIN-128. Folger, H.; Kaffrell, N. Aug 1973. (In German).
In annual report, 1972.

11480 (BMFT-FBK-73-22, pp 131-133) DETERMINATION OF THE YIELDS OF SHORT-LIVED CERIUM ISOTOPES FOR DIFFERENT TIMES OF OBSERVATION BETWEEN IRRADIATION AND SEPARATION OF THE CERIUM. Seyb, K. E. Aug 1973. (In German).
In annual report, 1972.

11481 (CEA-CONF-2407) ANALYSIS OF THE CROSS SECTION FOR CAPTURE AND INELASTIC SCATTERING OF THE ISOTOPES ^{99}Tc, ^{103}Rh, ^{127}I, ^{133}Cs, AND ^{139}La BETWEEN 1 keV AND 2 MeV. Krebs, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique Nucleaire). 1973. 25p. (In French). (CONF-730538-3). Dep. NTIS (U. S. Sales Only) $3.25.

From National Soviet conference on neutron physics; Kiev, USSR (28 May 1973).

For the purpose of establishing a library of evaluated neutron data on about 20 fission products, a calculation method based on the optical model and the statistical model was described and applied to ^{99}Tc, ^{103}Rh, ^{127}I, ^{133}Cs, and ^{139}La. The energy levels and the parameters of the compound nucleus were evaluated for these isotopes. (11 figures, 5 tables) (auth)

11482 (COO-3128-33) REACTION STUDIES WITH FAST NEUTRONS. Final Report, February 1, 1951–January 31, 1972. (Brown Univ., Providence, R. I. (USA)). 1973. Contract AT(11-1)-3128. 25p. Dep. NTIS $3.25.

Experimental and theoretical aspects of nuclear structure and reaction processes were studied in a 21-year program. Most of the experimental work was based on the analysis of charged particles (A ≤ 4) emitted from nuclei following bombardment by monoenergetic neutrons of 14 MeV or 2.5 MeV. The investigations also included neutron time-of-flight studies, reactions induced by charged particles, and polarization measurements. A program of work in theoretical nuclear physics was begun in 1967 and is continuing under another contract. (auth)

11483 (IKF-31) ANNUAL REPORT, 1972. (Frankfurt Univ. (West Germany). Institut fuer Kernphysik). 1972. 139p. (In German). Dep. NTIS (U. S. Sales Only) $9.00.

The work done at the Institut für Kernphysik in 1972 in the areas of nuclear reactions and nuclear structure, neutron diffractometry and spectroscopy, atomic scattering processes, solid state track detectors, nuclear analysis methods, radiation protection, and data processing are reported. (^{3}He,p) measurements on ^{29}Si, ^{23}Na, ^{19}F, ^{30}Si were carried out. The two-proton transfer reaction (^{3}He,n) was studied on ^{28,29,30}Si, ^{48}Ca, ^{49}Ti, ^{50}Ti, ^{53}Cr, ^{54}Fe, and ^{56}Fe. Excitation of collective states in ^{234}U and ^{236}U by inelastic deuteron scattering was investigated. The E2 and E4 matrix elements and deformation parameters of ^{152}Sm, ^{154}Sm, ^{158}Gd, ^{164}Dy, and ^{166}Er were determined. The proton-induced fission of ^{233,234,235,238}U was studied at incident energies from 5 to 30 MeV. Lifetime measurements were made of ^{39}Ca and ^{39}K. The level scheme of ^{59}Cu resulting from ^{58}Ni(p,γ)^{59}Cu reactions was determined. The proton binding energy was determined for ^{89}Y, ^{90}Zr, ^{91}Nb, and ^{93}Tc. The absolute effective cross section and the mechanism of the reaction ^{89}Y(p,γ)^{90}Zr were studied. Lifetime measurements were made on ^{90}Zr and ^{92}Mo using a particle–γ coincidence detector. The low-lying levels of ^{90}Zr and ^{91}Nb were investigated with the reactions ^{89}Y(p,γ)^{90}Zr, ^{90}Zr(p,γ)^{91}Nb, and ^{91}Zr(p,nγ)^{91}Nb. Level schemes were determined for ^{92}Mo, ^{93}Tc, ^{92}Nb, ^{107}Cd, ^{115}Sn, and ^{117}Sb. An improved time-of-flight spectrometer for heavy ions was developed. A delayed response of heavy-ion detectors because of the plasma effect was detected. A Compton polarimeter was developed for the measurement of the linear polarization of γ radiation. A transmission matrix method was developed for the calculation of the energy spectra of γ radiation scattered by thick shields. Experiments were made on the multiple scattering of electrons on detector material. Stabilization circuits were developed for γ–γ coincidence measurements. The mean square oscillations were calculated in the quasi-harmonic approximation for CsCl, CsBr, CsI, and TlBr and compared with experimental values. The lattice dynamics of rubidium halogenides were studied. The mean square deviations of LiF and LiD were determined. The secondary electron yield of C, Au, and Al foils and of KBr and LiF layers on carrier foils were measured as a function of the foil thickness. The detection probability of channel electron multipliers was measured as a function of the electron energy up to 10^4 eV. The energy spectra of electrons which were emitted in the passage of H and Ne projectiles with energy between 0.5 and 4 MeV through solid C, Al, Ag, and Au targets were measured. The angular straggling of H, He, N, and Ne was measured in solid targets of C, Al, Ni, Sb, and Au with thicknesses between 10 and 120 μg/cm^2 at energies between 1.8 and 11.0 MeV. The detector properties of AgCl single crystal layers were studied. The calibration of AgCl detectors was reported. Applications of nuclear methods and mass spectroscopy were discussed. The operation of the accelerator and reactor were reported. The publications of the Institute were tabulated. (JSR)

11484 (JINR-P1-7439) CHARACTERISTICS OF EMISSION OF π^0-, π^+-MESONS AND PROTONS IN HIGH-ENERGY π-MESON INTERACTIONS WITH Xe NUCLEI. Slovinskii, B.; Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of

High Energy). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The characteristics of π^0-, π^+-meson and proton emission: the momentum and angular spectra—are studied as well as the distribution over multiplicities in π^-Xe interactions at 2.34, 5 and 9 GeV/c. The possibility is shown of studying the nuclear reaction mechanism at high energies using the characteristics of π^0-mesons produced in these reactions. (auth)

11485 (JINR-P2-7436) QUASI-FREE INTERACTIONS IN FAST PION COLLISIONS WITH ATOMIC NUCLEI. Slovinskii, B. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The basic results of a study of π^-Xe interactions in the >1 GeV energy region, leading to the production of a small number of secondary charged particles, are presented. A simple statistical interpretation of these so-called quasi-free interactions is suggested. The calculated value for quasi-free branching ratios agrees well with experimental data. (auth)

11486 (NP-19873) ANNUAL REPORT, APRIL 1972–MARCH 1973. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 1973. 187p. Dep. NTIS (U. S. Sales Only) $11.50.

Operating data for the cyclotron and electron synchrotron, instrumentation, and research by the low- and high-energy physics divisions are reported. Activities of the cosmic-ray and theoretical physics divisions are reviewed. Information on various support groups, colloquia, publications, and staff is included. (RWR)

For title listings of selected papers see: 10880–10883, 11200, 11201, 11218, 11219, 11366, 11388, 11389, 11432–11435, 11456–11458, 11487–11492, 11508, 11509, 11518–11522, and 11685.

11487 (NP-19873, pp 41-43) ^{93}Nb(p,t)^{91}Nb AND ^{93}Nb(p,^{3}He)^{91}Zr REACTIONS. Tohei, T. (Tohoku Univ., Sendai); Nakagawa, T.; Yamaya, T.; Miura, K.; Ishii, K.; Endo, H. 1973.

11488 (NP-19873, pp 43-44) LOW-LYING LEVELS OF ^{94}Mo FROM THE ^{95}Mo(p,d) REACTION. Ishimatsu, T. (Tohoku Univ., Sendai); Hayashibe, S.; Kawamura, N.; Tsubota, H.; Saito, H. 1973.

11489 (NP-19873, pp 44-45) (p,t) REACTIONS ON THE ODD-N NUCLEI. Awaya, T. (Tokyo Univ.); Ohmura, H.; Ishimatsu, T. Hayashibe, S.; Kawamura, N.; Tsubota, H. Saito, H. 1973.

11490 (NP-19873, pp 47-49) ELASTIC AND INELASTIC SCATTERING OF 51.93 MeV PROTONS FROM ^{106}Pd, ^{108}Pd, AND ^{110}Pd. Koike, M. (Tokyo Univ.); Komura, K.; Pingel, K.; Wada, T.; Kamitsubo, H.; Fujisawa, T.; Inanaga, T.; Suehiro, T.; Nonaka, I. 1973.

11491 (NP-19873, pp 49-51) EFFECT OF INELASTIC SCATTERING PROCESSES ON (p,t) REACTIONS EXCITING THE FIRST 2^+ STATES IN Te, Sn, AND Cd ISOTOPES. Yagi, K. (Osaka Univ.); Aoki, Y.; Rangacharyulu, C.; Matoba, K.; Hyakutake, M.; Nidome, J. 1973.

11492 (NP-19873, pp 51-52) ^{122,124,126}Te(p,p') REACTION. Matoba, M. (Kyushu Univ.); Hyakutake, M.; Nidome, J.; Yagi, K.; Aoki, Y.; Murakami, H. 1973.

11493 (USIP-73-8) GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{103}Rh. Bargholtz, C.; Becker, J.; Eriksson, L.; Gidefeldt, L.; Holmberg, L.; Stefansson, V. (Stockholm Univ. (Sweden). Fysiska Institutionen). Apr 1973. 21p. Dep. NTIS (U.S. Sales Only) $3.25.

Gamma–gamma directional correlations in ^{103}Rh were measured in the decay of ^{103}Ru. No dependence on the chemical composition of the source was observed. The following directional correlation coefficients were determined: $A_2(557-57) = -0.064 \pm 0.003$, $A_2(444-57) = -0.035 \pm 0.013$. The lifetime of the 93 keV state was measured as $T_{\frac{1}{2}} = 1.06 \pm 0.05$ ns. By use of this value for the lifetime and the rotation in an external magnetic field of the directional correlation pattern, the gyromagnetic factor of the 93 keV state is obtained as $g = 1.07 \pm 0.17$. The properties of ^{103}Rh were calculated on basis of the unified vibrational model. The adequacy of this model for describing the positive-parity states studied in this work is discussed. (auth)

11494 INFLUENCE OF COULOMBIC FRAGMENTATION AT THE CROSS SECTION OF RESONANCE SCATTERING OF γ-RAYS IN THE CASE OF GASEOUS SOURCES. Dautov, L. M.; Kaipov, D. K.; Lysikov, Yu. A.; Madiyanov, T. N.; Tamendarov, M. F.; Shubnyi, Yu. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz. Mat.; No. 6, 79-81(1972). (In Russian).

On the basis of the charge distribution which arose as a result of electron capture in ^{114m}In, the resonance scattering cross section for 0.558 MeV γ-quanta by ^{114}Cd nuclei was calculated. The cross sections for gaseous sources InCl, InBr, and InI were, respectively, 10.6×10^{-26} cm^2, 9.1×10^{-26} cm^2, and 8.4×10^{-26} cm^2. This nonuniformity in the cross sections was explained by the proximity of the ion masses in InBr and InI, and by making allowance for the partiality in the temperature distribution and distribution of recoil momenta after neutrino emission. (tr-auth)

11495 DECAY PROPERTIES OF SHORT-LIVED, NEUTRON-RICH TECHNETIUM NUCLIDES. Huebscher, D. Mainz; Univ. Mainz (1971). 160p. (In German).

Thesis.

In the present dissertation a solvent extraction procedure for the rapid separation of short-lived neutron-rich Tc nuclides from fission products is described. The decay properties of the Tc isotopes 103, 104, 105, 106 and 107 are measured. Data obtained by means of U-238 fission with 14.7 MeV neutrons are checked by means of the fission reactions ^{238}U(n_{3f},f), ^{235}U(n_{th},f) and ^{232}Th(n_{14},f). Tc-102m, which until now has only been prepared by nuclear reactions, could not be found in the fission mixtures. From the ruthenium daughter isotopes, which have been separated, the mass numbers of the Tc isotopes could be derived. For Tc-108, a half-life of less than 6 sec is estimated. (70 figures, 27 tables) (tr-auth)

11496 Ge(Li)–Ge(Li) COINCIDENCE MEASUREMENTS IN ^{132}Xe. Singhal, N. C. (Vanderbilt Univ., Nashville); Hamilton, J. H.; Ramayya, A. V.; Pinajian, J. J. Rev. Phys. Appl.; 8: No. 3, 221-230(Sep 1973).

Gamma–gamma coincidence measurements were carried out on the decay of ^{132}I with two Ge(Li) detectors and a two-parameter system. Several new transitions were observed. From these results, 18 new levels at 2167.3, 2187.4, 2303.6, 2916.9, 2935.6, 2959.1, 3076.4, 3112.1, 3122.3, 3155.4, 3192.8, 3214.3, 3226.8, 3237.4, 3260.0, 3319.6, 3354.0 and 3385.1 keV were placed in the ^{132}Xe level scheme which incorporates 113 of the 119 definitely established gamma rays in this decay and can incorporate 5 of 16 additional tentatively reported transitions. (FR)

11497 (^{3}He,d) STRIPPING TO UNBOUND ANALOG STATES IN Nb ISOTOPES. Finkel, G. (Tel-Aviv Univ., Israel); Ashery, D.; Yavin, A. I.; Bruge, G.; Chaumeaux, A. Nucl. Phys.; A217: No. 1, 197-209(1973).

The (^{3}He,d) reaction was studied on all stable Zr isotopes. Twenty-three unbound analog states in the Nb isotopes were populated. The observed cross sections were analyzed by using two different methods for DWBA calculations of stripping to unbound analog states. The deduced proton spectroscopic factors are compared with the neutron spectroscopic factors obtained for the parent states from the (d,p) reaction studies. The agreement is generally good, except for the ^{97}Zr–^{97}Nb pair. The difference in the sensitivity to the transferred angular momentum between the (d,p) reaction and the (^{3}He,d) reaction to the analog states is discussed. The good agreement leads to the conclusion that the (^{3}He,d) reaction to analog states may be used in nuclear spectroscopy for the study of levels in the parent states which are populated through large angular momentum transfer. (10 figures, 4 tables) (auth)

11498 ENERGY LEVELS OF ^{92}Nb FROM ^{92}Zr(p,nγ)^{92}Nb. Kumabe, I.; Matsuki, S.; Nakamura, S.; Hyakutake, M.; Matoba, M.; Sato, T. (Kyushu Univ., Fukuoka). Nucl. Phys.; A218: No. 1, 201-212(1974).

The energy levels of ^{92}Nb were studied by means of the ^{92}Zr(p,nγ) reaction. The deexcitation γ-rays were observed with a high-resolution Ge(Li) detector in the proton energy range 3.00–4.80 MeV in steps of about 25 keV. Many new excited states of ^{92}Nb were populated by this reaction. Excitation energies up to 1.77 MeV were determined with high precision, and a level scheme of ^{92}Nb is proposed. From a Hauser–Feshbach analysis, the γ-decay scheme and other information, the spin-parities of many levels were assigned. (auth)

11499 METHOD OF SPIN ASSIGNMENT OF BOUND LEVELS POPULATED BY (n,γ) REACTIONS. Coceva, C.; Giacobbe, P.; Corvi, F.; Stefanon, M. (CBNM Euratom, Geel, Belg.). Nucl. Phys.; A218: No. 1, 61-83(1974).

The conditions are examined under which the spin of low-lying levels may be deduced from a comparison of the probabilities of populating such levels with γ-cascades starting from neutron capture states with different spins. To test this spin-assignment method low-energy γ-ray spectra from neutron capture in single resonances of ^{105}Pd and ^{177}Hf were measured, and the relative intensities of γ-transitions from low-excitation levels were determined. For each level the ratio between its populations from two different initial spin states is obtained and is found to provide a firm indication of the level spin. The experimental values of the population ratios are compared with the values obtained by a general formula based on simple statistical assumptions and by more

realistic Monte Carlo calculations of the γ-cascade. The perspectives of the method are discussed. (auth)

11500 BRANCHING RATIO FOR THE DECAY OF ^{135}I TO THE ISOMERS OF ^{135}Xe. Daniels, W. R.; Ford, G. P.; Hoffman, D. C.; Wolfsberg, K. (Los Alamos Scientific Lab., NM). J. Inorg. Nucl. Chem.; 36: No. 1, 201-203(Jan 1974).

In conjunction with an investigation of Xe fission yields, the branching ratio for the decay of 6.6-hr ^{135}I to ^{135m}Xe and ^{135g}Xe was remeasured. Fission product ^{135}I was produced in uranyl (^{235}U) stearate so that the high emanating power of the stearate could be utilized to effect a rapid purification of the Xe daughters. Xenon γ spectra were observed to determine the relative amounts of the two isomers which grew into an initially Xe-free ^{135}I source. (UK)

11501 DESCRIPTION OF FERMION SYSTEMS IN BOSON REPRESENTATIONS. V. A Boson Variational Approach to Collective Motion. Soerensen, B. (Univ. of Copenhagen). Nucl. Phys.; A217: No. 3, 505-524(1973).

The boson expansion method was developed with the purpose of continuously following even nuclear systems near their ground states, from the region of slightly anharmonic vibrations through the transitional region formed by a nonsharp phase transition to a region of permanent distortion characterized by the occurrence of rotational spectra. However, as the boson quantum was defined in the extreme vibrational limit, it was not possible to obtain quantitatively correct spectra in the transitional or deformed region. Believing that the major cause for the lack of success was the disregard of the self-consistent change of the basic degree of freedom, a simple variational method to be used with the boson expansion technique is presented. Its ability to cover the vibration-to-rotation transition is demonstrated by comparison with an exact solution for a four-level model with pairing force. Further the coverage of a quadrupole phase transition is shown for a system interacting via pairing-plus-quadrupole forces. A successful calculation of static quadrupole moments of Cd and Te isotopes is presented. Finally the approach in general situations with more complicated forces is discussed. (auth)

11502 STUDY OF THE ENERGY LEVELS OF ^{100}Mo USING NUCLEAR PHOTOEXCITATION. Moreh, R.; Wolf, A.; Shahal, O.; Tenenbaum, J.; Nof, A. (Nuclear Research Centre-Negev, Beer Sheva, Israel). Nucl. Phys.; A217: No. 3, 477-490(1973).

Elastic and inelastic scattering of monochromatic photons was used for studying nuclear energy levels in ^{100}Mo; the photons were produced by thermal neutron capture in titanium, copper and vanadium. The decay of the resonances at 7637, 6517 and 6418 keV was studied in detail. The angular distribution of some elastic and inelastic lines was measured and the following spin determinations were made: (kev, J^π); 535, 2^+; 694, 0^+; 1063, 2^+; 1462, 2^+; 2033, 0^+; 2040, 2^+; 5187, 1; 6418, 1^-; 6517, 1^-; 7637, 1^-. The parities of the last three levels were directly determined using a Compton polarimeter. Total radiative widths were measured and the following results were obtained: $\Gamma(6418) = 50 \pm 35$ MeV, $\Gamma(6517) = 180 \pm 100$ MeV and $\Gamma(7637) = 140 \pm 40$ MeV. The M2/E1 mixing ratios for two primary transitions were obtained. (auth)

11503 $\frac{9}{2}^+[624]$ GROUND STATE ROTATIONAL BAND IN ^{183}Os AND IN THE ADJACENT ISOTONES ^{181}W AND ^{179}Hf. Lindblad, T.; (Univ. of Stockholm); Bethoux, R.; Price, R. H.; Kleinheinz, P. Nucl. Phys.; A217: No. 3, 459-476(1973).

The ^{182}W(α,3n) reaction is used to populate the $\frac{9}{2}^+$ 624 ground state band in ^{183}Os up to the band member with spin $\frac{33}{2}$. The deviations of the rotational energies from the I(I + 1) rule are significantly more pronounced in ^{183}Os than those of the earlier investigated $\frac{9}{2}^+[624]$ ground bands in ^{181}W and ^{179}Hf. A monotonic trend of increasing energy perturbation towards higher atomic number Z is thus established for the three N = 107 isotones. The energies and transition probabilities of the $\frac{9}{2}^+[624]$ band in the three nuclei can be reproduced in a conventional seven-band (four parameter) Coriolis calculation provided the theoretical matrix elements are reduced. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 11447, 11473, 11483, 11528, and 11544.

11504 (AECL-4595, pp 17-18) BETA-GROUND BAND INTERACTION IN ^{156}Dy AT HIGH SPINS. Andrews, H. R.; Ward, D.; Graham, R. L.; Geiger, J. S. Jul 1973.

11505 (AECL-4595, p 43) ^{185,187}Re(n,γ) REACTION STUDIES. Lone, M. A.; Earle, E. D. Jul 1973.

11506 (BMFT-FBK-73-22, pp 96-102) NUCLEAR ISOMERISM IN PROMETHIUM-152. Wirth, G. Aug 1973. (In German).
In annual report, 1972.

11507 (BMFT-FBK-73-22, pp 107-115) BETA DECAYS OF ERBIUM-173 AND THULIUM-176. Dreisigacker, E.; Kaffrell, N.; Suemmerer, K. Aug 1973. (In German).
In annual report, 1972.

11508 (NP-19873, pp 52-54) (p,d) REACTIONS ON ODD DEFORMED NUCLEI. Ishizaki, Y. (Tokyo Univ.); Kato, S.; Pingel, K.; Kasagi, J.; Orihara, H.; Kanazawa, M.; Suehiro, T. 1973.

11509 (NP-19873, pp 55-56) MULTIPOLE MIXINGS IN THE INTERBAND TRANSITIONS OF ^{184}W. Kawakami, H.; Kusakari, H.; Ohya, S. (Tokyo Univ.). 1973.

11510 (n,γ)-CROSS-SECTION MEASUREMENTS OF ^{99}Tc, Eu, Sm, AND Fe IN THE ENERGY RANGE 1 eV TO 50 keV WITH A SLOWING-DOWN TIME SPECTROMETER. Chou, J.; Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Energy; 27: No. 11, 811-823(Nov 1973).

Absolute (n,γ) cross-sections of some fission products with high yield have been measured. In addition, Fe has been studied to remove some unexplained discrepancies in earlier cross-section measurements. Both the γ and the neutron detector have been calibrated absolutely, so the values derived are not normalized to some other (n,γ) cross-sections but rely on the $1/v$ dependence of the ^{10}B(n,α)^{7}Li and the thermal Au cross-section only. (auth)

11511 EFFECTIVE NEUTRON-PROTON INTERACTION IN THE RARE-EARTH NUCLEI. Nakagawa, K.; Obinata, T.; Sasaki, K. (Nihon Univ., Narashino, Japan). Nucl. Phys.; A217: No. 1, 71-77(1973).

Properties of the effective neutron-proton interaction of the doubly odd nuclei in the rare earth region are studied from the energy-level distance between the two rotational band heads and the mutual interaction energy between the last neutron and proton in the ground state. The result shows that the elongation of the force range has essentially the same effect as the decrease in the weight of the spin-spin term of the interaction, which is opposed to results obtained in the 1s-0d-shell region. This difference is discussed from the point of view of the pairing correlation. (3 figures, 3 tables) (auth)

11512 GAMMA-RAY SPECTRA AND POSITIVE PARITY BANDS IN ^{158}Gd. White, D. H. (Univ. of California, Berkeley); Siddiqi, T. A. Nucl. Phys.; A217: No. 2, 410-419(1973).

A Ge(Li)-NaI(Tl) pair spectrometer and a Ge(Li)-NaI(Tl) anti-Compton spectrometer were used to measure γ-rays from the reaction ^{157}Gd(n,γ)^{158}Gd. A detailed decay scheme for levels of ^{158}Gd was constructed up to an excitation energy of 2504 keV. Branching ratios for transitions from members of the positive parity bands to members of the ground state band were determined. It is shown that a single band-mixing parameter is not sufficient to explain the experimental results, and that even a four-band-mixing calculation does not provide satisfactory agreement. The binding energy of the last neutron is determined to be 7937.4 ± 0.7 keV. (auth)

11513 CORIOLIS COUPLING FOR $\frac{1}{2}$-[510] NEUTRON STATE IN ^{175}Lu. Gupta, D. K.; Sood, P. C. (Banaras Hindu Univ., India). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2133-2135(Jun 1973).

The level scheme of Minor et al was adopted, and a fitting was made to the level energies to deduce the admixture of the $\Delta K = \pm 1$ bands in the various levels of the two $K^\pi = 3^-$ and 4^- bands. (JFP)

11514 GENERATOR COORDINATE METHOD FOR SHAPE VIBRATIONS. Ansari, A. (Saha Inst. of Nuclear Physics, Calcutta); Nair, S. C. K. Nucl. Phys.; A217: No. 2, 245-252(1973).

The results of an investigation, with reference to ^{152}Sm, of the suitability of a simple generator coordinate wave function made up of angular momentum projected Nilsson BCS wave functions for the description of beta vibrations are reported. It is found that the harmonic approximation produces a pathological energy spectrum. On the other hand a discretized version yields better results. Also some numerical results concerning anharmonic quadrupole type vibrations about a spherical equilibrium shape are presented. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 10192, 11351, 11386, 11441, 11447, 11465, 11468, 11486, 11544, 11562, and 11568.

11515 (AECL-4595, pp 19-20) ALPHA EMITTERS NEAR N = 128: HALF LIVES OF ^{215}Fr AND ^{217}Th. Haeusser, O.; Witthuhn, W.; Alexander, T. K.; McDonald, A. B.; Milton, J. C. D.; Olin, A.; Skorka, S. J. Jul 1973.

11516 (JINR-P1-7475) SEARCH FOR TETRANEUTRONS IN REACTIONS OF π^--MESON DOUBLE CHARGE EXCHANGE ON HEAVY NUCLEI. Batusov, Yu. A.; Ganzorig, Zh.; Gumnerova, L.; Dudova, I. V.; Sidorov, V. M.; Khalkin, V. A.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Using the reactions of the double charge exchange of π^--mesons on (α) clusters of Pb nuclei and the ^{208}Pb(^{4}n,γ)^{212}Pb reaction a search was made for the nucleon stable tetra-neutrons. The identification of ^{212}Pb and its daughter products was performed by detecting α particles and measuring their energies. It is found that the upper limit of the cross section product for two hypothetical reactions does not exceed 10^{-34} cm^4. (auth)

11517 (LYCEN-7305) SPECTROSCOPIC STUDY OF THE ISOTOPES ^{202}Hg, ^{200}Hg, ^{198}Hg, AND ^{196}Hg. Beraud, R. (Lyon Univ. (France)). 1973. 98p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis.

This study of nuclear spectroscopy serves to complete the knowledge of the low-energy excitation levels of the nuclei ^{198,196}, ^{200,202}Hg, and makes it possible to follow the evolution of some essential characteristics as a function of the number of neutrons. The use of classical spectroscopic methods, made more precise by the use of semiconductor detectors, made it possible to determine the energies, intensities, and (in numerous cases) the nature of the transitions observed in the γ and electron spectra of ^{198,196}, ^{200,202}Tl, which by (e + β^+) decay populate the levels of the isotopes studied. Measurements of $\gamma-\gamma$ angular correlations led to the determination of a large number of spins and mixing parameters. The important acceleration factor ($\approx$ 25) of the E2 transitions between the levels with negative parity and the slowing ($\approx 10^5$) of the E1 ($5^- \rightarrow 4^+$) transitions were learned by determining by the delayed coincidence method the lifetimes of the 7^- and 5^- levels in the ^{198}Hg isotope. The interpretation in the framework of the intermediate-coupling model showed that the majority of the properties of the low-energy levels were well reproduced by a vibrator coupled with two proton holes. In the calculations account was taken of the excitation states up to 3 phonons with the configurations $(3s_{\frac{1}{2}})^{-1}$, $(2d_{\frac{3}{2}})^{-1}$, and $1h_{\frac{11}{2}})^{-1}$. It is noted that this model predicts a quadrupole moment of +0.8 b (approximately) for the 2_1^+ level, although up to now the even mercury nuclei were considered as spherical. (32 figures, 15 tables, 100 references) (JSR)

11518 (NP-19873, pp 56-57) g FACTOR OF THE 7^+ ISOMERIC STATE IN ^{202}Tl. Hashimoto, O. (Tokyo Univ.); Sumi, A.; Nomura, T.; Nagamiya, S.; Nakai, K.; Yamazaki, T.; Miyano, K. 1973.

11519 (NP-19873, pp 57-60) HIGH SPIN STATES IN EVEN LEAD ISOTOPES VIA THE (p,t) REACTION. Orihara, H. (Tokyo Univ.); Ishizaki, Y.; Trentelman, G. F.; Kanazawa, M.; Abe, K.; Yamaguchi, H. 1973.

11520 (NP-19873, pp 60-62) EFFECT OF DEUTERON BREAK-UP CHANNELS ON THE ^{208}Pb(p,d)^{207}Pb REACTION WITH E_p = 52 MeV. Yagi, K. (Osaka Univ.); Aoki, Y.; Murakami, H.; Matoba, M.; Hyakutake, M.; Nidome, J. 1973.

11521 (NP-19873, pp 65-66) OBSERVATION OF A TRANSITION OF 10.84 keV IN ^{206}Bi AND A NEW DECAY SCHEME FOR ^{206}Po. Kanbe, M.; Fujioka, M.; Hisatake, K. (Tokyo Inst. of Tech.). 1973.

11522 (NP-19873, pp 67-68) GROUND STATE BAND MEMBERS IN ^{236}U AND ^{230}Th STUDIED BY MEANS OF THE (p,t) REACTION. Takekoshi, H. (Japan Atomic Energy Research Inst., Tokyo); Ishizaki, Y.; Orihara, H.; Kanazawa, N.; Kasagi, J.; Koyama, K.; Matsuoka, N.; Takemasa, T. 1973.

11523 (NP-19892) 6.1 S ISOMER AND ROTATIONAL BANDS IN ^{192}Os. Research Report No. 13/1973. Pakkanen, A.; Heikkinen, D. W. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Jul 1973. 26p. Dep. NTIS (U.S. Sales Only) $3.50.

A (6.1 ± .2) s activity was observed when natural Os targets were bombarded with 14.5-MeV neutrons. This activity was assigned to the decay of a high-spin isomer in ^{192}Os at 2015.4 keV which is depopulated by M2 and E3 transitions. Singles and coicidence γ-ray spectra allowed the identification of seven new states in ^{192}Os. Several of these levels were placed in either the ground-state or γ-vibrational bands, which are strongly mixed. Excitation energies and B(E2) ratios for these bands are compared with different theoretical models. (3 figures, 4 tables) (auth)

11524 (UCID-15937(Rev.1), pp 7-9) NEUTRON TOTAL CROSS SECTION FOR ^{207}Pb NEAR 40 keV. Phillips, T. W.; Berman, B. L.; Bowman, C. D. 10 Nov 1971.

Status report to NCSAC.

11525 (UCID-16395, p 6) NEUTRON TOTAL CROSS SECTION OF ^{207}Pb. Phillips, T. W.; Berman, B. L. 14 Nov 1973.

In status report to USNDC.

11526 STUDY OF THE ^{193m}Hg + ^{195}Hg → ^{195}Au TRANSMUTATION. Vieu, C.; Peghaire, A.; Dionisio, J. S. (CNRS, Orsay, France). Rev. Phys. Appl.; 8: No. 3, 231-246(Sep 1973). (In French).

The electromagnetic transitions emitted by high-activity isotopically pure ^{193m}Hg and ^{195}Hg samples were extensively investigated with a double focusing $\pi\sqrt{2}$ spectrometer and Si(Li) or Ge(Li) spectrometers. The absolute intensities of all the transitions and more than fifty multipolarities were accurately determined. From these measurements, new spin and parity assignments were given to 18 levels of ^{195}Au, with medium to high excitation energies. In this nucleus, three levels are proposed at 637.8, 946.7 and 1443.2 keV. The ^{195}Au level scheme was interpreted according to the intermediate coupling models of Kisslinger–Sorensen and Alaga–Ialongo–Paar. Finally, the more or less collective character of the ^{195}Au and ^{195}Hg first levels was investigated from the detailed analysis of the reduced electromagnetic transition probabilities. (FR)

11527 ENERGY DEPENDENCE OF THE PARAMETER OF THE LEVEL DENSITY OF THE RESIDUAL NUCLEUS ^{209}Po. Itkis, M. G.; Kuvatov, K. G.; Magzumova, V. S.; Maratkanov, V. N.; Okolovich, V. N.; Rus'kina, G. Ya. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 46-50(1972). (In Russian).

The energy dependence of the fission cross section of the ^{209}Pb nucleus for 29 to 46 MeV α particles was measured. The value Γ_f/Γ_n was studied as a function of the excitation energy for the ^{210}Po nucleus. It is shown that for the region of excitation energy investigated during the calculation of the parameter of the density of levels of the residual ^{209}Po nucleus, it is important to allow for only part of the shell correction, since traditional analysis of the energy dependence of Γ_f/Γ_n at constant values of the parameters a_f and a_n does not correspond to actuality and represents a very coarse approximation. (tr-auth)

11528 STUDY OF FISSION FROM THE ^{84}Kr + ^{209}Bi INTERACTION: FUSION BETWEEN KRYPTON IONS AND HEAVY NUCLEI. Is it Possible? Lefort, M.; Ngo, C.; Peter, J.; Tamain, B. (Institut de Physique Nucleaire, Orsay, France). Nucl. Phys., A216: No. 1, 166-172(1973). (In French).

Fragments emitted in binary fission from complete fusion nuclei were investigated for krypton induced reactions on heavy nuclei. Cross sections are between 25 and 5% of the total reaction cross section. It is deduced that complete fusion between krypton projectiles and heavy nuclei is a very improbable process. Most of the reaction products seem to result from a very inelastic interaction which looks like very asymmetric fission. (auth)

11529 ANGULAR AND ENERGY DISTRIBUTIONS OF THE PRODUCTS OF DEUTERON DECAY IN THE COULOMB FIELD OF THE NUCLEUS. Evlanov, M. V.; Nemets, O. F.; Sokolov, M. V.; Struzhko, B. G. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1527-1531(Jul 1973). (In Russian).

The spallation cross section of deuterons in the Coulomb field of the nucleus was calculated by the method proposed by L. Landau and E. Lifshits. The angular correlations of the deuteron decay products at 12 and 13.6 MeV reacting with gold nuclei were obtained. The proton spectra arising in deuteron spallation reactions on Pb and Bi nuclei at 12 and 17 MeV were also reported. (tr-auth)

11530 MEASUREMENT OF THE g-FACTOR OF THE 0.57 ms 7^+ STATE IN ^{202}Tl. Hashimoto, O. (Tokyo Univ.); Sumi, A.; Nomura, T.; Nagamiya, S.; Nakai, K.; Yamazaki, T.; Miyano, K. Nucl. Phys.; A218: No. 1, 180-188(1974).

The spin rotation of the 0.57 ms 7^+ state in ^{202}Tl was observed by use of a pulsed magnetic field and the g-factor was determined to be 0.128 ± 0.006. The isomeric state was excited via the ^{204}Hg(p,3n)^{202}Tl reaction with a 28 MeV pulsed beam of 1.2 ms interval. From the results, the main configuration of the 7^+ state in ^{202}Tl is interpreted as $(\pi s_{\frac{1}{2}} \nu i_{\frac{13}{2}})$. (auth)

11531 GROUND-STATE α-DECAY OF N = 128 ISOTONES ^{210}Ra, ^{211}Ac, AND ^{212}Th. Nomura, T.; Hiruta, K.; Inamura, T.; Odera, M. (Inst. of Physical and Chemical Research, Saitama, Japan). Nucl. Phys.; A217: No. 2, 253-268(1973).

The α-decay properties of very short-lived N = 128 isotones, ^{216}Ra, ^{217}Ac and ^{218}Th, were investigated by the pulsed-beam method. Alpha emitters of interest were produced in the bombardment of ^{208}Pb or ^{209}Bi with 65 to 96 MeV ^{12}C or ^{14}N ions and α-decays were measured between natural beam bursts of the cyclotron. The results obtained are E_α = 9.349 ± 0.008 MeV and $t_{\frac{1}{2}}$ = 182 ± 10 ns for ^{216}Ra, 9.650 ± 0.010 MeV and 111 ± 7 ns for ^{217}Ac, 9.665 ± 0.010 MeV and 96 ± 7 ns for ^{218}Th. The experimental reduced α-widths of N = 128 isotones from ^{212}Po to ^{218}Th are shown to agree well with the simple shell model calculation. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 11348, 11351, 11383, 11447, 11473, 11480, 11558, and 12047.

11532 (BARC-694, pp 63-65) HIGH RESOLUTION MEASUREMENTS OF PROMPT GAMMA RAYS IN THE FISSION OF ^{252}Cf ACCOMPANIED BY LIGHT CHARGED PARTICLES. Ajitanand, N. N.; Choudhury, R. K.; Kapoor, S. S. 1973.

11533 (BMFT-FBK-73-22, pp 122-127) DETERMINATION OF THE FISSION YIELDS OF SHORT-LIVED HALOGEN ISOTOPES. Kratz, K. L. Aug 1973. (In German).
In annual report, 1972.

11534 (BMFT-FBK-73-22, pp 142-144) EXCITATION FUNCTIONS OF INCOMPLETE FUSION REACTIONS IN BOMBARDMENT OF URANIUM TARGETS WITH HEAVY IONS. Trautmann, N. Aug 1973. (In German).
In annual report, 1972.

11535 (JINR-E6-7419) SPIN ASSIGNMENT FOR SPONTANEOUSLY FISSIONING ISOMERS. Pham Zuy Hien. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.
A combined method of spin assignment for a spontaneously fissioning isomer is suggested, which is based on the isomer ratio and angular distribution of fission fragments. The method is applied to the case where two isomeric states are produced in the second potential well of the fission barrier. In particular, the problem of spin assignment for a two-quasiparticle isomer in even-even nuclei is considered. Numerical results for ^{238}Pu, produced by a reaction of the type (α,2n), are given. A comparison of the calculated and experimental data permits spin assignment and determination of the gamma branching ratio for the two-quasiparticle isomer ^{238}Pu. (auth)

11536 (JINR-P7-7409) EXPERIMENTS ON SUPERHEAVY NUCLEAR FUSION IN REACTIONS WITH Ge IONS. Flerov, G. N.; Oganesyan, Yu. Ts.; Lobanov, Yu. V.; Pleve, A. A.; Ter-Akop'yan, G. M.; Demin, A. G.; Tret'yakova, S. P.; Chepigin, V. I.; Tret'yakov, Yu. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
Experiments are described on superheavy nuclear fusion when bombarding ^{232}Th and ^{238}U with ^{74,76}Ge ions, accelerated in the tandem-cyclotron of the JINR. The experimental technique allows the spontaneous fission of isotopes with the half-life from 5 msec to 1 year to be recorded. The upper limit of the cross section of superheavy nucleus production in the (^{232}Th + ^{74,76}Ge)10^{-34} cm^2 reaction is found. The question is considered about the factors determining the value of the superheavy nucleus production cross section in the reactions of such a type. (auth)

11537 (NP-19798) DECAY OF ^{233}Pa TO THE LEVELS IN ^{233}U. Research Report No. 9, 1972. Valkeapaeae, T.; Siivola, A.; Graeffe, G. (Tampere Univ. of Tech. (Finland)). Dec 1972. 18p. Dep. NTIS (U.S. Sales Only) $3.00.
The decay of ^{233}Pa was studied by means of semiconductor detectors and coincidence techniques. In addition to the well known transitions and energy levels observed earlier in ^{233}U one could see some weak gamma transitions at energies 41.5, 248.0, 258.2 and 298.5 keV. The coincidence measurements establish a new level at 298.5 keV, which was assigned to $^1/_2$ − [743] single particle neutron state based on systematics and gamma transition rates. (auth)

11538 (UCID-15937(Rev.1)) STATUS REPORT TO NCSAC. Bowman, C. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Nov 1971. 26p. Dep. NTIS $3.50.
This status report by Lawrence Radiation Laboratory to NCSAC consists of brief papers on the following topics: neutron physics (6 papers); program for high-accuracy fission cross sections and $\bar{\nu}$ measurements (3 papers); fission cross sections on the transplutonium isotopes ^{242m}Am, ^{243}Cm, ^{245}Cm, ^{247}Cm, ^{249}Bk, and ^{249}Cf from 0.01 eV to 14 MeV (1 paper); photonuclear cross-section studies (3 papers); and bilateral position-sensitive γ-ray detector (3 papers). (9 figures) (RWR)
For title listings of selected papers see: 11436 and 11524.

11539 (UCID-16395, pp 1-2) FISSION $\bar{\nu}$ MEASUREMENTS. Howe, R. E.; Phillips, T. W.; Bowman, C. D. 14 Nov 1973.
In status report to USNDC.

11540 (UCID-16395, p 6) SPECTRUM OF HIGH-ENERGY γ RAYS FROM ^{252}Cf SPONTANEOUS FISSION. Dietrich, F. S.; Browne, J. C.; O'Connell, W. J.; Kay, M. J. 14 Nov 1973.
In status report to USNDC.

11541 (UCRL-51458) COMPILATION OF FISSION PRODUCT YIELDS IN USE AT THE LAWRENCE LIVERMORE LABORATORY. Nethaway, D. R.; Barton, G. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1973. Contract W-7405-Eng-48. 106p. Dep. NTIS $5.45.
A list of the fission product yields presently used by the Radiochemistry Division of the Lawrence Livermore Laboratory is given. The list includes fission of ^{232}Th, ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu induced by thermal, fission-spectrum, and 14.8-MeV neutrons. Data for 111 nuclides ranging from ^{66}Ni to ^{175}Yb are included. This compilation differs from some others in that not all mass numbers are covered; rather, the selection is limited to those major fission products that are useful in the nuclear test program radiochemical diagnostics and in basic studies of the fission process. The compilation includes all fission data available as of August 1973. (13 figures, 2 tables) (auth)

11542 (UCRL-51478) DETERMINATION OF ABSOLUTE FISSION CROSS SECTION RATIOS USING THE METHOD OF THRESHOLD CROSS SECTIONS. Behrens, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Nov 1973. Contract W-7405-Eng-48. 4p. Dep. NTIS $4.00.
Fission cross section measurements for a collection of uranium and plutonium isotopes are presently being made at LLL by using the 100-MeV electron linear accelerator as a pulsed source for neutrons. The cross sections are measured as a function of neutron energy from 15 MeV down to thermal energy by using the time-of-flight technique. For neutron energies above 1 MeV, a new method for determining absolute fission cross section ratios is used. This method, called the method of threshold cross sections, gives absolute fission cross section ratios without the need for determining the absolute masses of fissionable material within fission chambers. An explanation of the threshold cross section method is given, and an example is cited for the absolute ratio σ_f(238): σ_f(235) above 1 MeV. (auth)

11543 NEW NUCLIDE NOBELIUM-259. Silva, R. J. (Oak Ridge National Lab., TN); Dittner, P. F.; Mallory, M. L.; Keller, O. L.; Eskola, K.; Eskola, P.; Nurmia, M.; Ghiorso, A. Nucl. Phys., A216: No. 1, 97-108(1973).
A new, relatively long-lived isotope of element 102 was produced through the bombardment of ^{248}Cm with ^{18}O ions at both Oak Ridge and Berkeley. A maximum of approximately 20 nb occurs in the production cross section at a bombarding energy of 93 MeV. A total half-life of 58 ± 5 min was computed from the combined data of both laboratories. Five α-particle groups were observed in the decay with the following energies and abundances: 7.685 (11%), 7.605 (14%), 7.533 (23%), 7.500 (39%) and 7.455 MeV (13%). A spontaneous-fission branch of about 20% relative to the α-emission appears to accompany the decay. The atomic number was assigned on the basis of characteristic ion-exchange column behavior; the mass assignment was made from the growth of the α-decay daughter, ^{255}Fm, into chemically separated samples. The Z and A assignment is corroborated by nuclear reaction data and consistent with α-decay energy systematic. (auth)

11544 QUASIMOLECULAR STATE AND REGGE POLES. Fuller, R. C. (Univ., Heidelberg). Nucl. Phys., A216: No. 1, 199-216(1973).
The quasimolecular or shape resonance in heavy ion physics occurs in peripheral partial waves. A broad peripheral resonance is conveniently described in terms of a Regge pole which provides an economical description of the angular asymmetry of a broad peripheral resonance which can decay before the ions rotate about the interaction region. The quasimolecular resonance can be considered as a decaying surface wave propagating around the region of strong absorption into the shadow where it provides the dominant contribution to the wave function. The rate of decay in angle of the surface wave as well as its period of oscillation are simply related to the Regge pole angular momentum. The same analysis

applies to the scattering angular distribution at back angles and explains both the characteristic oscillation at back angles and the exponential decrease toward back angles. Numerical calculations of both the surface wave and the scattering angular distribution are provided to corroborate the theoretical discussion. An explanation is offered in terms of a Regge pole of the McCarthy peak in the wave function in the shadow of an absorptive optical potential. (auth)

11545 MASS DISTRIBUTION OF FISSION FRAGMENTS IN SYMMETRIC PHOTOFISSION OF ^{235}U AND ^{237}Np. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A. At. Energ. (USSR); 35: No. 3, 214-215(Sep 1973). (In Russian).

To determine the precise shape of the mass distribution curve, the yields of six products of the symmetric and almost symmetric fission of ^{235}U by bremsstrahlung photons with a maximum energy of 14 MeV were measured. The results, which are compared in the article with similar data for ^{237}Np and ^{232}Th, verify the existence of separate groups of final fission products in a symmetrical field. Apparently, with an activation energy of about 10 MeV, mass number 236 is the critical value for the mass of the fissioning nucleus from the standpoint of resolution of this group in experimental curves of mass distribution. (2 figures, 1 table) (TTT)

11546 YIELDS OF FISSION FRAGMENTS IN ^{237}Np PHOTOFISSION. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A.; Teodorovich, O. A. At. Energ. (USSR); 35: No. 3, 211-213 (Sep 1973). (In Russian).

The subject yields are tabulated for 24 fission products and plotted in a "rabbit-ear" curve. The values were obtained in ^{237}Np fission with betatron bremsstrahlung of 10 to 24 MeV. (1 figure, 1 table) (MWG)

11547 LEVELS OF ^{234}Pa POPULATED IN THE DECAY OF ^{234}Th. Godart, J.; Gizon, A. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A217: No. 1, 159-176(1973). (In French).

The energy levels populated by β decay of ^{234}Th were investigated with two iron-free double-focusing spectrometers and several Ge(Li) detectors. The decay scheme includes the following levels of ^{234m}Pa, denoted by I, π and energy (in keV): 0^-(0), 2^-(29.49), 1^-(92.38), 1^+(92.80), (1^-) (103.35), 1^+(112.80), and (2^+) (132.9). The negative-parity levels were analyzed with the configuration $p_{1/2}^{-1}|530\uparrow\rangle - n_{1/2}^{+1}|631\downarrow\rangle$; it is necessary to include more than one configuration for the positive-parity levels. An attempt was made to explain the feeding of ^{234}Pa (UZ). (7 figures, 3 tables) (auth)

11548 ENERGY LEVELS IN EVEN ACTINIDE ISOTOPES FROM (t,p) REACTIONS. Back, B. B. (Los Alamos Scientific Lab., NM); Flynn, E. R.; Hansen, O.; Casten, R. D.; Garrett, J. D. Nucl. Phys.; A217: No. 1, 116-124(1973).

Energy levels in ^{232,234}Th, ^{236,238,240}U and in ^{250}Cm were measured by using the (t,p) reaction. Angular distributions were obtained for the ^{234,238}U targets, and evidence for second-order effects in the direct reaction mechanism was found. (5 figures, 3 tables) (auth)

11549 SPINS OF LOW-ENERGY NEUTRON RESONANCES IN ^{235}U. Reddingius, E. R.; Postma, H.; Olsen, C. E.; Rorer, D. C.; Sailor, V. L. (Brookhaven National Lab., Upton, NY). Nucl. Phys.; A218: No. 1, 84-94(1974).

The spins of 15 resonances in the ^{235}U slow neutron cross section lying in the neutron energy range between 0.1 and 15 eV were determined by measuring the transmission of polarized monoenergetic neutrons through a target in which the ^{235}U nuclei were polarized. The magnetic moment of ^{235}U is concluded to be negative. (auth)

11550 IDENTIFICATION OF THE NUCLIDE ^{226}U. Viola, V. E. Jr.; Minor, M. M.; Roche, C. T. (Univ. of Maryland, College Park). Nucl. Phys.; A217: No. 2, 372-380(1973).

Identification of the uranium isotope ^{226}U is reported. This nuclide was produced in bombardments of ^{232}Th with 140-MeV ^{4}He ions. It is observed to decay by α-particle emission with a half-life of 0.5 ± 0.2 sec and has an α-particle energy of E_α = 7.43 ± 0.03 MeV, giving a Q-value of Q_α = 7.56 ± 0.03 MeV. Detection was achieved by on-line counting and pulsed-cyclotron beam techniques. It is also observed that the maximum yields for (α,p(x−1)n) reactions are about ten times greater than those for (α,xn) reactions at these energies. (auth)

11551 THEORETICAL PREDICTIONS OF FISSION HALF-LIVES OF ELEMENTS WITH Z BETWEEN 92 AND 106. Randrup, J. (Univ. of California, Berkeley); Tsang, C. F.; Moeller, P.; Nilsson, S. G.; Larsson, S. E. Nucl. Phys.; A217: No. 2, 221-237(1973).

Ground-state and isomeric fission half-lives are studied for nuclei with Z between 92 and 106. Realistic fission-barrier potentials are established on the basis of a modified liquid-drop model and the modified-oscillator single-particle model, including the effects of reflection asymmetry and axial asymmetry. These barriers, in combination with available experimental half-lives, are used to determine a smooth fission inertial-mass function with only one adjustable parameter. This semi-empirical inertia reproduces the normal fission half-lives in this region to within a factor of 25 on the average. Calculations suggest that the longest-lived doubly even isotope of the element 106 occurs for N = 152 with a half-life of around 100 μsec. Furthermore, the hindrance associated with fission of odd-A nuclei is studied for a few selected cases. A particularly large hindrance factor is obtained for N = 157 for Fm, No and Z = 104 and attributed to the $[615^3/_2{}^+]$ neutron orbital. The abrupt drop in half-lives from ^{256}Fm to ^{258}Fm is also discussed and interpreted as the decline of the second-barrier peak below the ground-state level. (auth)

11552 MULTILEVEL EFFECTS IN THE UNRESOLVED RESONANCES REGION OF THE CROSS SECTIONS OF FISSILE NUCLIDES. de Saussure, G.; Perez, R. B. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 52: No. 3, 382-395(Nov 1973).

For the specification of the cross sections of the fissile isotopes in the neutron energy region of unresolved resonances, the single-level formalism is often used, while an analysis of the cross sections in the resolved region indicates that a multilevel formula may be more appropriate. The statistical properties of the cross sections generated by using the single-level formalism are compared with those obtained by a multilevel formulation. The multilevel parameters were chosen to give the same average cross sections as the single-level formalism. The comparison indicates that there are small, but significant, differences between the statistical properties of the cross sections obtained with the multilevel formalism and those obtained with the single-level formula. The differences are probably too small, particularly when Doppler broadening is considered, to affect reactor calculations. (11 figures, 10 tables) (auth)

11553 FISSIONABILITY AND CRITICALITY: FROM PROTACTINIUM TO CALIFORNIUM AND BEYOND. Clayton, E. D. (Battelle Northwest, Richland, WA). Nucl. Sci. Eng.; 52: No. 3, 417-420(Nov 1973).

An empirical correlation of k_∞ of a nucleus with the difference between its neutron binding energy and activation energy for fission, based on available data, suggests the possibility of providing estimates of k_∞ of other heavy even-neutron nuclides. Calculated values of the activation and binding energies for nuclides ranging from $^{233}_{90}$Th to $^{254}_{99}$Es are tabulated together with the known critical (fissionability) parameters. The evidence also suggests that it is possible to achieve criticality with the naturally occurring protactinium isotope, $^{233}_{91}$Pa. (1 figure, 1 table) (auth)

11554 ESTIMATION OF FISSION CROSS SECTION AND RANGE OF FISSION FRAGMENT BY MEANS OF TRACK REGISTRATION. Koshijima, T. (National Inst. of Radiological Sciences, Chiba, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 511-512(Aug 1973).

The range of fission fragment penetration in uranylacetate was measured by the method of track registration, and an estimate made of the effective fission cross section of natural uranium for neutrons from a Ra−Be source. (JFP)

11555 VALUE OF THE DECAY CONSTANT FOR SPONTANEOUS FISSION OF ^{238}U. Nishimura, S. (Kyoto Univ.). Ganseki Kobutsu Kosho Gakkaishi; 67: No. 4, 139-142(Apr 1972). (In Japanese).

The fission track method is used to determine the decay constant for spontaneous fission of ^{238}U. The decay constant to be λ_f = $(7.0 \pm 0.3) \times 10^{-17}$ (y^{-1}). On the other hand, for the close checking of fission track ages with the other ages, the same sample used for the dating by the other methods was used. From the results, it may be concluded that 6.85×10^{-17} (y^{-1}) (Fleischer and Price, 1964) is the probable apparent decay constant of spontaneous fission of ^{238}U for geochronology within experimental error. (auth)

11556 MEASUREMENT OF FISSION PRODUCT YIELDS FROM ^{232}Th IN A ^{252}Cf FISSION NEUTRON SPECTRUM. Deen, J. R. Austin, TX; Univ. of Texas (1973). 153p. University Microfilms Order No. 73-25,996.

Thesis (Ph. D.).

The absolute comulative fission yield of Ba-140 and the relative yields of I-131, Te-132, and Ce-141 were measured for Th-232 irradiated in a fission spectrum of neutrons. The irradiation was performed using two Th-232 foils in contact with a nominal one milligram Cf-252 source in a large evacuated area for 41 days. The absolute yield of Ba-140 was deduced from an absolute measurement of its daughter product La-140 using a calibrated NaI(Tl) detector. The activities of I-131, Te-132, and Ce-141

were measured relative to the 1596 keV γ ray of La-140 using a 43 cm^3 Ge(Li) detector. The fission rate of the thorium foils and the integral fission cross section of the Th-232 were measured using mica solid state track recorders. (Diss. Abstr. Int., B)

Nuclear Theory

Refer also to abstracts 11164, 11287, 11312, 11386, 11390, 11391, and 11722.

11557 (BARC-694, pp 52-56) SYSTEMATICS OF THE GROUND STATE SPINS OF THE SPHERICAL ODD–ODD NUCLEI. Saini, S.; Gupta, S. K. 1973.

11558 (BARC-694, pp 69-72) SINGLE PARTICLE EFFECTS ON FISSION BARRIER AND STATISTICAL INTERPRETATION OF FRAGMENT ANISOTROPIES AND MASS DIVISION IN FISSION. Kapoor, S. S.; Ramamurthy, V. S. 1973.

11559 (BNL-18366) TRENDS IN NUCLEAR PHYSICS: WHAT CAN WE LEARN FROM HIGH ENERGY INTERACTIONS? Goldhaber, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 8p. (CONF-730815-7). Dep. NTIS $3.00.

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973).

Elementary particles are discussed regarding their implications for nuclear physics. In particular, hadronic atoms, hypernuclei, and the virtual existence of Δ's in the nucleus are considered. (JFP)

11560 (HU-TFT-73-20) SINGULAR-CORE-INTERACTION AND ONE-PION-EXCHANGE CONSTRAINTS ON THE OFF-SHELL TWO-NUCLEON T-MATRIX. Kim, Y. E.; Tubis, A. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

A method is given for generalizing the Baranger et al.–Haftel construction of the off-shell two-nucleon T-matrix so as to incorporate the constraints due to singular core interactions (described by the boundary condition model) and the one-pion exchange tail of the two-nucleon potential. (auth)

11561 (HU-TFT-73-22) CORRELATIONS BETWEEN NUCLEONS AND Δ's. Green, A. M.; Haapakoski, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

The Δ is treated on the same footing as a nucleon by introducing components containing the Δ explicitly into the nuclear wave function. The main aim is to obtain the form of the Δ-component, i.e., its percentage probability and spacial dependence. (FI)

11562 (INP-823) MICROSCOPIC MODEL OF THE ELASTIC SCATTERING OF MEDIUM ENERGY ALPHA PARTICLES. Budzanowski, A.; Dudek, A.; Grotowski, K.; Majka, Z.; Strzalkowski, A. (Institute of Nuclear Physics, Krakow (Poland)). Dec 1972. 31p. Dep. NTIS (U. S. Sales Only) $3.75.

A microscopic description of the elastic scattering of medium-energy alpha particles is given in terms of an optical potential calculated from an effective nucleon–nucleon interaction and the nuclear matter distribution in both colliding nuclei. The model and its properties are studied for $45 \leq A \leq 208$ with an effective nucleon–nucleon interaction of Slanina–McManus form. The double-folding procedure applied results in a form factor of the real potential different from the Saxon–Woods one. Good agreement with experimental data is obtained with a predicted real potential depth of about 200 MeV. (6 figures, 1 table) (auth)

11563 (JINR-P4-7316) NUCLEUS AS A QUANTUM ANALOG OF ELASTIC BODY. Afanas'ev, G. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The quantum theory is constructed for collective motions in nuclei, which is based on the classical elastic body theory. It is shown that such a model assumes the existence of a rotational band in spherical nuclei. A systematic comparison of this model with the Bohr–Mottelson model is made. (auth)

11564 (JINR-P4-7479) REACTION OF "COMPLETE DISINTEGRATION" OF NUCLEI. Toneev, V. D.; Chigrinov, S. E. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

Cascade-evaporation model is used for analysis of deep nuclear spallation initiated by high-energy protons and α-particles. The model is shown to explain the basic characteristics of the "complete disintegration" of nuclei including the probability value of such a process. The disagreement with experiment points out to the necessity of taking into account of many-particle collisions inside the nucleus and the process of nonequilibrium nuclear decay. (auth)

11565 (LNF-73-5) CALCULATION OF THE (γ,N) CROSS SECTION OF NUCLEI AT INTERMEDIATE ENERGY. Rottigni, G. A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 14 Feb 1973. 14p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.00.

The expression for the cross section was derived in its most general form, unconnected to particular wave functions by the nucleon state. The expression is not in the long-wavelength approximation of the photon, and is valid up to a photon energy comparable with the meson source. It takes into consideration all the multipoles of the electromagnetic interaction. (JSR)

11566 (LYCEN-7319) SU_4 INVARIANTS AND NUCLEAR BINDING ENERGY. Maguin, C. (Lyon Univ. (France)). 1973. 89p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis.

The purpose of the present study was to see if a complete mathematical formulation, employing an ensemble of three fundamental SU_4 invariants, can supplement the work of Franzini and Radicati on supermultiplets. The basic concepts of this theory are reviewed. As the existence of supermultiplets postulates that of nuclear forces independent of charge, but as Nature imposes the presence of Coulomb forces between protons, the necessary Coulomb correction of the experimental binding energies is derived. Other corrections to be introduced are also derived. After a brief review of the concept of invariants in U_4 and its sub-group SU_4, a study of the physical significance of the various operators used is undertaken. In order to determine if the use of a complete system of SU_4 invariants would yield more knowledge on nuclear forces, two ensembles were used: the Gelfand invariants and the Biedenharn invariants. For each ensemble a mass formula was deduced for the nuclear binding energy. (13 figures, 9 tables) (JSR)

11567 NUCLEAR SHAPES, ENERGY GAPS, AND PHASE TRANSITIONS. Kumar, K. (Vanderbilt Univ., Nashville). Phys. Scr.; 6: No. 5-6, 270-282(1972).

From symposium on high-spin nuclear states and related phenomena; Stockholm, Sweden (30 May 1972).

A survey is given of our current understanding of nuclear phase transitions caused by sharp changes in nuclear shapes and energy gaps. Phase diagrams and criteria for normal–superfluid–normal and spherical–prolate–oblate–spherical phase transitions are presented. The superfluid–normal phase transition and the associated "back-bending" phenomenon observed at high spins are discussed in some detail. The constrainted-Hartree–Bogolyubov treatment of the pairing-plus-quadrupole model, developed by the present author, explains the 50% increase in the moment of inertia of ^{160}Dy as J increases from 2 to 16, is capable of producing the back-bending effect, and predicts a Coriolis-Anti-Stretching effect at high spins. (INIS)

11568 GENERALIZED THEORY OF α-DECAY. Baktybaev, K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 31-37(1972). (In Russian).

A novel variant in the theory of α-decay systematically taking into account the nuclear interactions of an α-particle with a daughter nucleus is described. The theory does not include any adjusted parameters. The absolute widths of ^{212}Po levels were calculated as an example. The approach employed allowed for configuration mixing and made it possible to obtain absolute values of α-decay widths which were extremely close to experimental values. (tr-auth)

11569 MICROSCOPIC MODEL OF QUADRUPOLAR EXCITATIONS AND ALPHA-PARTICLE SCATTERING. Gonchar, V. Yu.; Inopin, E. V.; Mel'nik, Yu. P.; Yushkov, A. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 77-78(1972). (In Russian).

A calculation of nuclear matrix elements was performed for an excitation of the 2^+ states of spherical even–even nuclei on the basis of a nuclear model, allowing for coupling of nucleons and a quadrupole-quadrupole interaction. A comparison with experimental values revealed satisfactory agreement between theoretical and measured values of matrix elements. (tr-auth)

11570 CHANGES IN CHARGE RADIUS OF NUCLEI DURING EXCITATION. Dautov, L. M.; Kadykenov, M. M.; Kaipov, D. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 6, 37-41(1972). (In Russian).

Values of $\Delta R/R$ relative changes in charge radius for the majority of Moessbauer nuclei were obtained by combining x-ray and Moessbauer spectra with the method of isomeric shifts in isostructural compounds. Empirical rules for determining the sign of $\Delta R/R$ values for odd nuclei located outside

of regions of deformation. The influence of shell effects on the magnitude of the charge radius of a nucleus was elucidated. The theory of finite Fermi systems in the correct determination of the character of transitions yields the proper signs for $\Delta R/R$ in most cases. (tr-auth)

11571 ALPHA CLUSTERING EFFECTS IN NUCLEAR MATTER. Brink, D. M.; Castro, J. J. (Oxford Univ.). Nucl. Phys., A216: No. 1, 109-124(1973).

The importance of α-clustering effects in the interior region of heavy nuclei is estimated by studying the existence of such phenomena in infinite nuclear matter assuming a crystalline type of structure where each lattice site is occupied by an α-particle. The crystalline α-matter is described in terms of the microscopic α-particle model of Margenau, Bloch and Brink and its saturation properties are compared with those of the plane wave model for two different nucleon-nucleon interactions, namely the Brink and Boeker and the Skyrme interactions. It is shown that at normal densities of nuclear matter the plane wave model turns out to be more stable than the α-cluster, indicating that the α-type correlations are not important in the interior region of heavy nuclei, however at a density of approximately one-third of the central nuclear density a transition from the independent particle model to the correlated α-cluster crystalline model occurs, suggesting the importance of such correlation on the nuclear surface. (auth)

11572 STUDIES ON STATISTICALLY EXCITED SHELL MODEL NUCLEI: THE DEPENDENCE OF THE SHELL STRUCTURE AND OF THE PAIRING CORRELATION UPON ANGULAR MOMENTUM. Moretto, L. G. (Univ. of California, Berkeley). Nucl. Phys., A216: No. 1, 1-28(1973).

The statistical properties of excited shell model nuclei with the inclusion of the angular momentum and of the pairing correlation are studied. Particular attention is dedicated to the dependence of the shell effects and of the superfluid properties upon angular momentum. The statistical functions, generated from the pairing Hamiltonian properly generalized to account for angular momentum, are calculated for various nuclei on the basis of the Nilsson model. The neutron and proton gap parameters are evaluated as a function of temperature and angular momentum. The dependence of the critical angular momenta and of the critical temperatures upon the physical quantities characterizing the nucleus is discussed. The question of the existence of a second order phase transition associated with the disappearance of the pairing correlation is considered. The temperature scale is transformed to the excitation-energy scale and the yrast line, as well as other energy-angular-momentum isotherms, are calculated. The evaluation of the thermodynamical quantities for the combined system of neutrons and protons is discussed in detail. As a final product, the level densities as a function of angular momentum and excitation energy are obtained. (auth)

11573 NEW GIANT RESONANCES. Suzuki, T. (Inst. of Physical and Chemical Research, Saitama, Japan). Nucl. Phys.; A217: No. 1, 182-188(1973).

The excitation energies for giant monopole and quadrupole resonances are estimated by using self-consistent field theory. The mass parameters for these oscillations are determined by using classical energy-weighted sum-rule values. It is predicted that both the isoscalar monopole and quadrupole states have an eigenfrequency of $1.41\ \omega_0[\omega_0 \approx 41/A^{\frac{1}{3}}\text{MeV}]$ and that the isovector monopole and quadrupole resonances will appear at $E_x \approx 4.35\ \omega_0$ and $3.16\ \omega_0$, respectively. The systematics of the excitation energies for the observed new giant resonances are well explained by the simple model. (1 figure) (auth)

11574 RECENT DEVELOPMENTS IN THE THEORY OF STRIPPING TO UNBOUND STATES. Barz, H. W.; Bunakov, V. E.; El-Naiem, A. M. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Nucl. Phys.; A217: No. 1, 141-158(1973).

A comparative analysis is carried out of different approaches to the calculation of DWBA cross sections for stripping to unbound states including single-particle resonances, compound resonances, and the smooth background. A relationship is derived between unbound stripping and scattering cross sections on the same target. The reliability of spectroscopic factor concepts is discussed. Numerical checks are performed with the aid of stripping form factors obtained from the solution of a coupled-channels equation system. (7 figures) (auth)

11575 COLLECTIVE TREATMENT OF THE PAIRING HAMILTONIAN. IV. The Yrast Approximation. Bes, D. R.; Dussel, G. G.; Maqueda, E. E.; Perazzo, R. P. J. (Comision Nacional de Energia Atomic, Buenos Aires). Nucl. Phys.; A217: No. 1, 93-115(1973).

The pairing collective excitations are analyzed within the framework of the yrast approximation. The states are supposed to have a large isospin and a large number of pairs outside the doubly magic core. The large centrifugal terms that are, therefore, present induce a stable deformation in isospin and gauge spaces. A complete and physically meaningful classification of states is obtained in terms of rotations and small oscillations. This description reproduces the known harmonic results concerning energies and pair transfer matrix elements to leading order in the yrast quantum number, Y, which is suitably defined. It is also shown how to introduce corrections to this zeroth-order description. For this purpose a modification of the usual perturbation theory is developed. It is also shown how anharmonic terms may be introduced simultaneously with the above-mentioned corrections. (1 figure, 3 tables) (auth)

11576 STATE DEPENDENCE OF PAIRING MATRIX ELEMENTS. Glas, D.; Mosel, U. (Univ., Giessen, Ger.). Nucl. Phys.; A216: No. 3, 563-573(1973).

The influence of the state dependence of pairing matrix elements on deformation energies was investigated. The prolate-oblate model was found to be too arbitrary for this purpose. Calculations using a δ force show variations of the pairing energies of up to 1 MeV. The correlation between these matrix elements and a prolateness parameter was investigated, as well as the deformation dependence of some critical gaps in the actinides. Both the prolate-oblate model and the δ-force calculations yield the result that the oblate $\frac{1}{2}[400]$ proton state should decouple as strongly as the $\frac{1}{2}[501]$ neutron state. This finding offers a test for the prolate-oblate model. Finally, some remarks are made on BCS-type calculations near the scission point, where due to the increasing separation of the fragments the assumption of a constant pairing matrix element between all states becomes unphysical. (6 figures) (auth)

11577 ISOSCALAR DIPOLE RESONANCES. Deal, T. J. (Brown Univ., Providence). Nucl. Phys.; A217: No. 1, 210-220 (1973).

The question of electromagnetic isoscalar dipole transitions is briefly reviewed. An energy-weighted sum rule (corrected for c.m. effects) is applied and used with a doorway dominance approximation to predict inelastic form factors. Questions concerning the nature of the excited state are seen to be answerable with the sum rule. (5 figures) (auth)

11578 SOLIDIFICATION OF NEUTRON MATTER. Pandharipande, V. R. (Univ. of Illinois, Urbana). Nucl. Phys.; A217: No. 1, 1-13(1973).

The effect of the angular momentum dependence of the neutron-neutron interaction on the solidification of neutron matter is investigated by using the Reid interaction and the lowest order constrained variational method. In agreement with previous estimates the solidification density with an average state-independent interaction is estimated to be $\approx 2.1\ \text{n/fm}^3$. However, the exchange and particularly the extra attraction in $l = 0$ states greatly favor the fluid phase, and no indication of solidification is obtained up to $\rho = 3.6\ \text{n/fm}^3$ when the l dependence of the interaction is considered. (4 figures, 4 tables) (auth)

11579 LOW LYING 2^+ AND 3^- STATES IN EVEN-EVEN SPHERICAL NUCLEI. Vdovin, A. I.; Stoyanov, Ch.; Shirikova, N. Yu. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 37: No. 7, 1543-1550(Jul 1973). (In Russian).

The low 2^+ and 3^- states of spherical nuclei are studied. Within the framework of the semimicroscopic approach these states were studied in both the harmonic and the anharmonic approximations. In the latter case only the interaction between low lying quadrupole phonons was considered. The connection of quadrupole oscillations with octopoles and with noncollective branches of the excitation was considered. This made it possible to calculate anharmonic corrections both to the 2^+ and the 3^- states. (J.S.R.)

11580 DIAGRAMMATIC METHODS AND RENORMALIZATION IN THE IWAMOTO-YAMADA CLUSTER EXPANSION. Schaefer, L. (Univ., Heidelberg). J. Math. Phys. (N.Y.); 14: No. 10, 1299-1307(Oct 1973).

Diagrammatic methods are developed which give the explicit expression for the nth order term of the linked Iwamoto-Yamada cluster expansion in terms of the cluster integrals. The method applies independently of the number A of particles of the system. Partial summations are carried through which for finite A result in a representation of the expansion by skeleton diagrams, whereas in the limit $A \to \infty$ the expansion is reduced to two analytical equations. In addition, for finite A the renormalization establishes a connection between the expectation value of an arbitrary operator and the probability to find n hole states, $1 \le n \le A$, occupied. Simple considerations raise some doubts concerning the convergence of the unrenormalized expansion. (auth)

11581 OVERLAPPING RESONANCES AND UNITARITY OF THE SCATTERING MATRIX. Simonius, M. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Phys.; A218: No. 1, 53-60(1974).

An automatically unitary product expansion for a scattering matrix with arbitrary overlapping resonances is discussed and used to derive sum rules for the resonance parameters. Problems with the implementation of time-reversal invariance are pointed out. (auth)

11582 HARTREE-FOCK DISTORTION ENERGY OF THE NUCLEUS. Strutinskii, V. M. (Inst. of Nuclear Research, Kiev). Nucl. Phys.; A218: No. 1, 169-179(1974).

The Hartree-Fock energy of a nucleus in an external field is expressed in terms of two auxiliary density matrices. One of them is a smoothed distribution $\bar{\rho}$ which generates the non-selfconsistent deformed shell-model potential and is directly related to the nuclear shape. The other represents the volume polarization effect by the external field. The final expression suggests a possibility of a two-mode model for the nuclear vibrations. Renormalization of smoothed quantities by means of phenomenological models is indicated. (auth)

11583 SOME APPLICATIONS OF CANONICAL TRANSFORMATIONS IN BARGMANN HILBERT SPACE. Kramer, P.; Schenzle, D. (Univ., Tuebingen, Ger.). Rev. Mex. Fis.; 22: No. 1-2, 25-44 (1973).

The relation between the Hilbert space H of quantum mechanics and the Hilbert space F of entire analytic functions introduced by Bargmann is used to derive unitary projective representations of the group SL(2,R) of linear canonical transformations. These representations are applied to an analysis of various nuclear models. (auth)

11584 LOW-ENERGY LEVEL-SPACING DISTRIBUTION IN THE NUCLEAR TABLE. Flores, J.; Mello, P. A. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 185-198 (1973).

The nuclei in the nuclear table are considered as a realization of an ensemble of Hamiltonians, and the distribution of spacings s_{01} between the ground and first excited state is analyzed. It is shown that, once nuclei with a systematic s_{01} behavior are eliminated, s_{01}, measured in units of its average, follows a Poisson distribution. (auth)

11585 GROUP THEORY OF α-CLUSTER CONFIGURATIONS. Seligman, T. H. (Univ., Tuebingen, Ger.). Rev. Mex. Fis.; 22: No. 1-2, 151-170(1973).

The α-cluster ansatz for α-like nuclei leads to the introduction of a group of permutations of the clusters. It proves to be a useful tool to study the ansatz and to simplify the antisymmetrization of α-cluster functions. The method is applied to the calculation of two-body matrix elements. The algebraic part of this problem is completely solved. The number of coefficients that appear is significantly reduced and all coefficients are given either explicitly or implicitly through a generating function. (auth)

11586 CURVATURE CORRECTION IN THE NUCLEAR MASS FORMULA. Bauer, M.; Dohnert, L. (Univ. Central de Venezuela, Caracas). Rev. Mex. Fis.; 22: No. 1-2, 135-149(1973).

The curvature correction to the nuclear binding energy is obtained by using an averaged level density appropriate to describe, up to curvature effects, the independent particle aspect of the nuclear many-body problem. The relation between the surface and curvature coefficients is seen to depend exclusively on the radius of the nucleus and the behavior of the wave functions at the surface. Corresponding to a realistic surface term, the curvature correction is found to be such that it increases the binding energy, although the actual value is very sensitive to the parametrization of the nuclear radius in terms of the mass number. (auth)

11587 BASIS FUNCTIONS FOR THE NUCLEAR THREE-BODY PROBLEM. Chacon, E. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 97-113(1973).

Closed algebraic expressions are given for complete (but non-orthogonal) sets of functions, adequate for the quantum mechanical description of the translationally invariant orbital motion of three identical particles. The functions appear as linear combinations of hyperspherical harmonics with good permutational and orbital angular momentum symmetries. Both the two-dimensional and the three-dimensional problems are discussed. (auth)

11588 COMPUTATION OF TOTAL AND DIFFERENTIAL CROSS SECTION FOR COMPOUND NUCLEAR REACTIONS OF THE TYPE (a,a), (a,a'), (a,b), (a,γ), (a,$\gamma-\gamma$), (a,bγ), AND (a,b$\gamma-\gamma$). IV. FORTRAN program CINDY. Sheldon, E.; Rogers, V. C. (Lowell Tech. Inst., MA). Comput. Phys. Commun.; 6: No. 3, 99-131(Sep 1973).

The computer program CINDY written in FORTRAN IV for the IBM 370/165 and IBM 360/50 is described for the evaluation of total and differential cross sections in absolute and normalized form for the processes in j-j coupling formalism using statistical compound nucleus theory with spin-orbit interaction and/or the Moldauer level width fluctuation correction if desired. (JFP)

11589 SINGLE-PARTICLE POTENTIAL OF RENORMALIZED BRUECKNER THEORY. Schaefer, L. (Univ., Heidelberg). Nucl. Phys.; A217: No. 2, 361-371(1973).

Evaluating the set of all factorizable insertions, closed expressions are derived for the single-particle potential of renormalized Brueckner theory. The implications of these results are discussed. In this way a number of results previously established by diagrammatic methods are derived. Bounds on the single-particle energies are established, and the existence of solutions of the self-consistency problem is proven. The solution can be made unique by requiring maximum occupation of the subspace of hole states. (auth)

11590 HIGH-SPIN COLLECTIVE STATES AND AXIAL ASYMMETRY. I. Macroscopic model. Turner, R. J.; Kishimoto, T. (Univ. of Copenhagen). Nucl. Phys.; A217: No. 2, 317-341(1973).

The onset of axially asymmetric nuclear shapes in high spin collective states is investigated from a macroscopic point of view. A mathematical framework for the discussion of the dynamics of quadrupole collective motion is developed for the coupled system of rotation and γ-vibration. Energy spectra, electric quadrupole moments and transition probabilities are calculated. The systematic deviations from the predictions of the axially symmetric rotor model resulting from a possible phase transition to an asymmetric shape are discussed for the yrast region. Effects of higher order terms in the kinetic energy are also indicated. (auth)

11591 METHOD OF NUCLEAR STRUCTURE CALCULATION WITH CLUSTER COUPLING SCHEME. Suzuki, Y. (Niigata Univ., Japan). Progr. Theor. Phys. (Kyoto); 50: No. 1, 341-343(Jul 1973).

A method of explicitly calculating the kernel in the resonating group method in the harmonic oscillator basis is proposed, which enables some problems on molecular states to be treated with the cluster coupling shell model scheme. (LBS)

11592 NUCLEAR-MATTER CALCULATIONS WITH REALISTIC SEPARABLE NUCLEON-NUCLEON INTERACTIONS. Meunier, J. P.; Pigeon, J.; Nahabetian, R. (Univ., Lyon). Lett. Nuovo Cim.; 8: No. 14, 839-843(1 Dec 1973).

A recently proposed set of nonlocal separable potentials in infinite nuclear matter is examined. The saturation properties of these potentials are investigated by calculating the binding energy per particle, saturation density, compressibility modulus, and defect parameter for nuclear matter. For this purpose, the Brueckner theory is used to first order (in G-matrix) with the standard approximations. (LBS)

11593 PROTON-NEUTRON POLARIZATION. Yoshimura, S. (Waseda Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 50: No. 1, 334-336(Jul 1973).

The role of proton-neutron polarization in the Goldhaber and Teller model for the energy of the photonuclear giant resonance is investigated. The resonance energies are calculated for the best parameters and the results are in agreement with experiment. It is concluded that by applying the model obtained for the proton-neutron polarization to the dipole polarization of fission fragments, the result is reached that the polarization produces only a small effect on the fission barrier. (LBS)

11594 INTERMEDIATE-STATE DECAY RATES IN THE EXCITON MODEL. Gadioli, E.; Gadioli Erba, E.; Sona, P. G. (Univ., Milan). Nucl. Phys.; A217: No. 3, 589-610(1973).

New calculations of the decay rates (for particle emission and exciton-exciton interactions) of the intermediate states of the composite nucleus, during equilibration, are reported. In these calculations, densities of p-particle, h-hole states corresponding to nonequidistant single-nucleon state spacings were used. The decay rates for particle emission were estimated with the detailed balance principle, while a semiphenomenological approach is proposed to evaluate the decay rates for exciton-exciton interactions. In principle, these decay rates can be evaluated starting from the probabilities per unit time of particle-particle and hole-hole collisions inside the nucleus. Inspection of experimental data, however, indicates that although the energy and exciton number dependence of the decay rates appear to be reasonable, the absolute value is too high. The required reduction is obtained by normalizing the theoretical value of the decay rate of a 2p-1h excited system to the experimental one deduced from the study of (p,n) reactions. This procedure is somewhat tentative, the underlying difficulty being the lack of basic knowledge of the nucleon-nucleon scattering cross section in nuclear matter. However, the use of the deduced decay

rates appears to allow consistent reproduction of absolute cross sections for proton induced reactions in nuclei of widely differing mass, in the incident energy interval ≈15 to ≈50 MeV. (auth)

11595 FLUCTUATION ENERGIES IN SF MODEL AND PHENOMENON OF SHRINKAGE. Mantri, A. N.; Sood, P. C. (Banaras Hindu Univ., India). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1369-1371(Apr 1973).

By correctly defining the fluctuation energy (FE) in the shape fluctuation model, a correlation of its spin variation with that of nuclear moments of inertia is established; it is then shown that the "shrinkage" recently observed for some hard rotors may correspond to positive FE in this model. Results of calculations for the nuclei ^{120}Xe, ^{184}Pt, ^{186}Os, ^{168}Yb, and ^{180}Hf are tabulated. (1 table) (RWR)

PHYSICS (PLASMA AND THERMONUCLEAR)

11596 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 11, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 50p.

Confinement and Heating

Refer also to abstract 11644.

11597 (CEA-CONF-2410) THE RF-HEATING APPROACH TO THE IGNITION PROBLEM IN LOW-β TORI. Canobbio, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). 1973. 12p. (CONF-730705-17). Dep. NTIS (U. S. Sales Only) $3.00.

From 6th European conference on controlled fusion and plasma physics; Moscow, USSR (30 Jul 1973).

Additional nonohmic heating is necessary to get ignition in low-β tori. Besides neutral injection, a number of rf-heating methods are shown to have favorable thermonuclear prospects on the basis of the known theoretical scaling laws. The main areas for future work are indicated by stressing the need of a systematic experimental investigation of rf heating under conditions that are relevant to the ignition problem. (auth)

11598 (COO-2277-2) HIGH-β CAPTURE AND MIRROR CONFINEMENT OF LASER-PRODUCED PLASMAS. Semiannual Report, February 1–July 31, 1973. Haught, A. F.; Polk, D. H.; Woo, J. T.; Fader, W. J.; Tomlinson, R. G.; Jong, R. A.; Ard, W. B. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). 31 Jul 1973. Contract AT(11-1)-2277. 62p. (UARL-M-921514-19). Dep. NTIS $5.25.

The United Aircraft Research Laboratories are engaged in a program to investigate the use of a dense, mirror-confined, laser-produced plasma as the target for a neutral-injection beam and to examine this technique for establishing and maintaining a high-temperature, high-density, steady-state, mirror-confined fusion plasma. The program is a direct extension of the current UARL investigations of the capture and confinement of laser-produced plasmas in a minimum-B mirror field. The overall program plan of the UARL Laser-Initiated Target Experiment involves four parts. The first of these is the laser heating of a solid particle positioned within the experiment chamber by an ultrahigh-vacuum suspension system to create a fully ionized plasma of ~10^{16} to 10^{17} ions and electrons at a temperature of 0.5 to 1 keV. The second part of the program is the capture and confinement of the high-temperature laser-produced plasma to form a stable, high-density (>10^{13} cm^{-3}), mirror-confined target plasma which fills an appreciable fraction of the mirror field volume. Heating of the confined-target plasma to ~10 keV by charge-exchange interaction with an injected energetic neutral beam comprises the third part of the program, and the fourth is the creation of a collisional, steady-state, mirror-confined plasma by ionization of the neutral beam on the energetic target. Experiments have demonstrated the required laser plasma heating, plasma capture, and stable mirror confinement, and initial evidence has been obtained on the field volume filling. Fokker–Planck and rate-equation calculations of the plasma heating and evolution to steady state with neutral-beam injection were carried out, and it was established that this technique can be used to form a steady-state, injection-sustained, mirror-confined 10-keV plasma at a density >10^{12} cm^{-3} with beam parameters and vacuum conditions that lie within the current state-of-the-art. During the period plasmas with average energies up to ~keV containing more than 10^{16} hydrogen ions have been generated from ~60-μm-diameter lithium hydride particles within the baseball coil minimum-B mirror field; development was undertaken of an ultrahigh-vacuum feedback particle suspension system; measurements were made that show effective filling of the containment field by the mirror-confined plasma; the rate-equation analysis of the target plasma evolution to a steady state sustained by neutral-beam injection was used to explore the experimental parameters for the injection studies; and detailed design of the beamline system for the injection experiments was carried out, based on a self-consistent analysis of the beamline vacuum conditions and pumping requirements. These experimental and theoretical results are described along with the design of the neutral beam for the injection experiments. (auth)

11599 (IAE-2254) TURBULENT HEATING OF PLASMA BY A CURRENT IN A "TOKAMAK". Azizov, R. I.; Ivanov, A. A.; Zinov'ev, O. A.; Kalinnikov, G. I.; Nedoseev, S. L.; Rakhimbabaev, Ya. R.; Rusanov, V. D.; Titov, A. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An experimental study is reported of turbulent heating in small toroidal systems with currents, when the vortex pulsed emf is directed parallel with the longitudinal magnetic field, creating by discharge capacitances on the copper casing covering the ceramic vacuum chamber. On the basis of these results, conclusions are drawn on the perspectives of the proposed method of heating for large toroidal systems of the tokamak type with metallic liner. Calculations are made for the installation with turbulent heating and the principal electrical circuit for the creation of the longitudinal current. (tr-auth)

11600 (IPPCZ-169) MICROWAVE HEATING OF ELECTRONS OF A DENSE PLASMA COLUMN AT FREQUENCIES HIGHER THAN THE ELECTRON CYCLOTRON FREQUENCY. Part I. Datlov, J.; Kryska, L.; Budnikov, V. N. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Sep 1972. 19p. INIS.

The absorption of plasma waves excited in a dense plasma column was investigated and the localization of the regions of efficient electron heating was determined in a broad range of plasma parameters. The heating of electrons near the second electron cyclotron harmonic was investigated in more detail. (auth)

11601 (ORNL-TM-4432) RUNAWAY ELECTRON DYNAMICS. Spong, D.; Clarke, J. F. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

A self-consistent model of the runaway electron acceleration process is developed that includes electron drift orbits. Two new effects indicated by the analysis are a shrinkage of the beam with time and a limitation of the maximum attainable γ, $\gamma_{max} \lesssim (\omega_{ce}/\omega_{pe})^2$, in such a beam. For the Ormak runaway regime data, these results are minor corrections to a previously developed model that did not include drift orbits. However, for higher-energy-density runaway beams, the drift orbit effects may become significant. (auth)

11602 (UCID-16371) HIGH-DENSITY FUSION AND THE Z-PINCH. Hartman, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1973. Contract W-7405-eng-48. 28p. Dep. NTIS $3.50.

Some arguments are presented for going to high-density fusion (Lawson time $\tau < 10^{-5}$ sec), and for the contention that magnetic confinement in excess of the fastest hydromagnetic growth time does occur for some z-pinch configurations. Four ways of forming z-pinches are described. (MOW)

11603 KINEMATIC STUDY OF NEUTRALIZED ELECTRON RINGS. Ikuta, K. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 258-260(Jul 1973).

Injection of a neutralized relativistic electron ring into a toroidal plasma is shown to increase the toroidal plasma current, provided the aspect ratio (minor to major radius ratio) of the ring is at least $\eta^{-\frac{1}{2}}$ times larger than that of the toroidal plasma, where η is the ratio of the major radius of the ring to the major radius of the ring after coalescence. (auth)

11604 EXPERIMENTS ON THE INTERACTION OF A CO_2 LASER BEAM WITH A MAGNETICALLY CONFINED PLASMA COLUMN. Amherd, N. A. Seattle; Univ. of Washington (1973). 114p. University Microfilms Order No. 73-27,636.

Thesis (Ph.D.).

One of the possible methods to achieve thermonuclear fusion conditions employs laser heating of a magnetically confined plasma. Absorption of the beam by the mechanism of inverse bremsstrahlung requires long plasma lengths, of the order of hundreds of meters at 10 keV. For an irradiated plasma column, however, the characteristic length for refraction effects can be much shorter than the absorption length. Favorable refraction occurs in a plasma column having a density minimum on-axis, for then the beam can be trapped within the axial region of the plasma as if in a light-pipe. This results in a stable heating geometry and enhanced absorption because of longer ray paths. The phenomena of laser beam trapping and absorption by a deuterium plasma were demonstrated by use of a theta pinch device axially irradiated by a CO_2 TEA laser. The density range was 10^{16} to 10^{17} cm^{-3} and the nonirradiated plasma temperature range upwards from

1.3 eV. Time- and space-resolved measurements of the radiation transmitted through the plasma showed periods of favorable refraction during the implosion phase of the plasma dynamics, i.e., when the plasma had the form of a hollow cylinder. As the density increased near the axis, then absorption became important. A dramatic illustration of beam trapping was obtained by use of laser's ability to burn marks on black Polaroid film. Placing the film at the transmission end of the pinch device showed enhanced burning on the plasma axis when a favorable plasma density profile existed during the irradiation. Temperature measurements of the irradiated plasma showed a temperature increase at those times when the beam was trapped. The maximum observed increase was 2 eV from an initial state of about 1.3 eV. The results of these heating experiments agree with calculations based upon classical collisional absorption theory. One further effect of the laser beam was an elongation of the plasma column by up to factors of two. This resulted from laser-induced heating and ionization in the cold, weakly ionized end regions of the plasma. The maximum laser intensity was 10^8 W/cm^2. (Diss. Abstr. Int., B)

Diagnostics

Refer also to abstract 11170.

11605 (CEA-CONF-2313) APPLICATION OF MICROWAVES AND FAR INFRARED TO THE PROBLEMS OF DIAGNOSTICS IN RESEARCH ON CONTROLLED FUSION. Etievant, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1973. 21p. (In French). (CONF-730551-2). Dep. NTIS (U.S. Sales Only) $3.25.

From first French-Spanish colloquium on microwaves meeting; Madrid, Spain (21 May 1973).

Several actual problems of hyperfrequency diagnostics studied in the laboratories at Fontenay-aux-Roses in the framework of studies on controlled fusion are presented. Measurement of high plasma densities by submillimetric interferometry, determination of density profiles by multibeam interferometry and by reflectometry, study of turbulence by microwave scattering, and measurements of the magnetic field components by Faraday rotation and by a method using the nonlinear properties of the plasma are discussed. (6 figures, 17 references) (tr-auth)

11606 (CEA-CONF-2314) MEASUREMENT OF THE PROFILE OF ELECTRON DENSITY IN AN INHOMOGENEOUS PLASMA. Crenn, J. P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 15p. (In French). (CONF-730551-1). Dep. NTIS (U.S. Sales Only) $3.00.

From first French-Spanish colloquium on microwaves meeting; Madrid, Spain (21 May 1973).

The electron density profile in an inhomogeneous plasma was measured using a ten-path hyperfrequency interferometer operating at a frequency of 140 GHz. This interferometer is described. The principle of the interferometric measurement is outlined. The measurements are based on a dephasing between the measurement path and a reference path. The factors governing the selection of the wavelength and of the number of channels are discussed. The associated electronics are described. (JSR)

11607 (CEA-R-4489) MEASUREMENT OF THE ION TEMPERATURE OF THE PLASMA FOCUS USING RUBY SCATTERING. Jolas, A. (CEA Centre d'Etudes de Limeil, 94, Villeneuve-Saint-Georges (France)). Dec 1973. 84p. Dep. NTIS (U.S. Sales Only) $6.25.

The plasma focus is studied by analyzing the ruby laser light scattered by electron density fluctuations in order to measure the ion temperature. The study begins with observations of the light scattered at 90° from the incident laser beam. The experimental setup is described and the results are interpreted. To remain in the case of cooperative scattering ($\alpha > 1$) during the neutron emission, the scattered light is observed "forward" at 7° from the laser beam. The spectral analysis is done with a Fabry–Perot interference etalon coupled to a Fafnir-type multichannel system. Some spectra of scattered light are in agreement with Salpeter's theoretical profiles that assume Maxwellian velocity distributions for electrons and ions. In these cases, the ion temperature does not exceed 1 keV. On the contrary, other spectra probably indicate anomalous scattering. (auth)

11608 (IPP-III-10) DIFFRACTION IMAGE OF A FINITE SIZE OBJECT IN AN ANNULAR APERTURE SYSTEM. Sesnic, S.; Fujita, J.; Pohl, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

The intensity and phase distributions near the geometrical focus of an error-free pencil of monochromatic light bounded by an annular aperture are obtained. The numerical results for a single point scatterer (point source) and for a cylindrical, homogeneous collection of stationary scatterers are discussed. If the central obstruction is kept small, an increase in the size of the scattering volume results in an increase in the size of the central image, across which the intensity and the phase are fairly constant. For medium and large central obstructions, the numerical results indicate very small or no changes in the central image size if the scattering volume is increased. This might cause rather severe alignment restrictions if one wanted to use extreme forward laser scattering combined with wave mixing to study tokamak-like plasmas. (auth)

11609 (IPPCZ-134) MICROWAVE MEASUREMENT OF RADIAL AND AXIAL ELECTRON DENSITY PROFILES IN A PLASMA COLUMN. Bohacek, V. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Oct 1971. 32p. INIS.

The method of applying microwave cavities in the determination of the radial and axial profiles of electron density in a plasma cylinder of a given radius is dealt with. The method is based on approximating the profiles by means of a finite power series with unknown coefficients and on determining these coefficients from the resonant frequency shifts of microwave cavities. The accuracy of the method and the accuracy of the measurements are discussed, special attention being devoted to the selection of suitable cavity modes. (auth)

11610 (ORNL-tr-2744) DEVELOPMENT OF A METHOD OF PROBING ELECTRIC AND MAGNETIC FIELDS IN A PLASMA WITH BEAMS OF CHARGED PARTICLES. Morozov, A. I.; Dauter, B. V.; Temchin, S. M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. Translated by Martha Gerrard from IAE-2195. 35p. Dep. NTIS $3.75.

Problems related to using beam probes in plasmas are described. The theory is described and experiments carried out earlier on this subject are reviewed. (28 references) (auth)

11611 CHARACTERISTICS OF PROBE WITH AN ORIFICE IN GAS PLASMA. Amemiya, H. (Nagoya Univ., Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 2, 63-72(Jun 1973).

In order to measure electron and ion currents more accurately than by a Langmuir probe, an orifice is provided on the surface of a plane probe. Only charged particles of a desired kind that pass through this orifice are accelerated and collected by a collector behind the hole. It is shown that the characteristics of a probe of this type (orifice probe) are influenced by the collector potential in such a way that the currents show some peaks and increase with the acceleration voltage. This might be due to the field penetration, by which the electron current can have a peak at the space potential, while the ion current has a peak at a lower voltage. Further, a lens effect occurs near the floating potential, which causes another peak of ion current. Data on three types, i.e. immersion-lens type, Faraday-cup type, and prism type are given. An improvement of retarding-potential characteristics is obtained by use of prism-type collectors which ensure a reduction of field penetration. (auth)

11612 UTILIZATION OF DIGITAL SPECTRAL ANALYSIS TECHNIQUES IN THE STUDY OF PLASMA FLUCTUATION DATA. Smith, D. E. Austin, TX; Univ. of Texas (1973). 157p. University Microfilms Order No. 73-25,088.

Thesis (Ph. D.).

A 7-channel, 1.5-MHz bandwidth, analog–digital data acquisition system was developed to interface an experimental situation with a large core-storage digital computer. This enables experimentally generated data to be used in conjunction with digitally implemented spectral analysis techniques. The purpose of this project is to utilize these spectral analysis techniques in the study of plasma fluctuation data associated with instabilities and turbulence. This study is unique in that these spectral analysis techniques allow one to determine both the frequency ω and spatial wavenumber k associated with several waves simultaneously present in the plasma. This ability to measure ω and k enables one to compute the phase velocity of each wave and thereby identify coherent oscillations buried in a noisy environment. One is also able to verify resonant frequency and wavenumber selection rules associated with nonlinear interactions of waves in the plasma. These same techniques allow one to compute the spectral index associated with a turbulent power spectrum while simultaneously measuring k versus ω, the latter information being needed to compare theory and experimental data. This data acquisition and spectral analysis system has been utilized in the study of the evolution of drift wave turbulence under various experimental conditions. (Diss. Abstr. Int., B)

Kinetics (General)

Refer also to abstract 11393.

11613 (IPPCZ-165) EFFECT OF TRAPPED BEAM ELECTRONS ON NONLINEAR BEAM–PLASMA INTERACTION. Jungwirth, K.; Piffl, V.; Ullschmied, J. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Jun 1972. 51p. INIS.

The experimental and theoretical results are discussed of a study on the Cherenkov type ($\omega \approx k_\parallel v_b$) of the nonlinear interaction of a cold electron beam with a magnetized plasma. In the initial stage, a single quasi-monochromatic wave determining the dynamics of the nonlinear interaction was excited in the system. Then the energy released by the slowing down of the beam as a whole was mainly transferred to the excited wave. The problem may be solved numerically, for any combination of ω_{pb}^2, $\omega_{pb_\perp}^2$, ω_B^2, v_b, $k_\parallel$ and k simultaneously. Experimentally, the averaged beam distribution function in various stages of the interaction, the phase velocity of the excited wave, and the spatial dependence of its amplitude were measured. Satellites of the basic wave were observed and their frequencies determined. In the regimes in which a single strong wave is excited, agreement was found between the calculated and the measured values. If, however, the transit time of the beam electrons exceeded by a few reciprocal growth rates $\delta\bar{\Gamma}^1$ the time interval necessary for reaching the first maximum of the basic wave amplitude, the excitation of satellite waves with comparable amplitudes but lower frequencies and the "over-relaxation" of the beam were observed. A possible physical mechanism of this phenomenon is suggested. (auth)

11614 (ITEF-10) DISTRIBUTION FUNCTION OF IONS GENERATED IN ELECTRON RINGS. Drozdovskii, A. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1973. 16p. (In Russian). INIS.

The storage of ions in electron rings was investigated. Distribution functions of singly charged ions during equilibrium distribution of the electron density were obtained. It was shown that the intrinsic field of the ions does not affect directly their motion. Some characteristics of the behavior of the two-component rings were examined. (tr-auth)

11615 EMISSION OF ELECTRON CYCLOTRON HARMONICS FROM A NON-MAXWELLIAN PLASMA. Vasiliyev, M. P.; Kuznetsov, Y. K.; Paulichenko, O. S. (Physical-Technical Inst., Kharkov). Plasma Phys.; 15: No. 8, 807-817(Aug 1973).

Microwave emission of electron cyclotron harmonics from a plasma of a reflex discharge was investigated. It was shown that besides the phenomenon of emission of electron cyclotron harmonics with a comparatively low intensity and broad emission lines, a new type of emission takes place. This emission has extremely high-intensity, narrow emission lines and is emanated in a form of short pulses. The main properties of this phenomenon are explained in terms of exitation of electron plasma waves by a group of nonequilibrium electrons with isotropic velocity distribution. (auth)

11616 INTERACTION OF GAS CROSS FLOW WITH ELECTROMAGNETIC FIELDS. Bose, T. K. (Insdian Inst. of Tech., Madras). Plasma Phys.; 15: No. 8, 819-824(Aug 1973).

The effect of cross-flow blowing on an arc between a pair of electrodes was studied theoretically by extending the generalized Ohm's law to include collisional exchange of momentum from the directed velocity of the heavy particles to the comparatively light electrons. The analysis has been extended to a case in which there is an external magnetic field perpendicular to both electric and gas cross-flow fields, so that the analysis is applicable to both aerodynamically and magnetically balanced arcs. An expression is given to compute the arc shape for a magnetically balanced arc between parallel rail electrodes, where uniform electric and magnetic fields are assumed. The theoretical results are compared qualitatively with experimental results. (auth)

11617 STATISTICS OF ELECTRON VELOCITIES IN CROSSED FIELDS. Roshal, A. S.; Romanov, P. V. Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 12, 1948-1951(Jun 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 12, 2501-2507(Dec 1972).

Results are presented of a theoretical investigation of the mean and mean-square electron velocities and the electron temperature in a stream propagating in crossed electric and magnetic fields. The results are obtained by computer simulation using the method of large particles. The electric field in the interaction region is made up of a static field and an rf field produced by traveling electromagnetic waves. The electron flow is maintained by thermal emission and secondary emission from the cathode. Plane and cylindrical flows are considered. It is found that the flow is almost laminar over a considerable region; the velocity distribution is significantly different from that in the so-called Brillouin flow. The electron temperature in crossed fields is very high, reaching several million degrees. This shows the high degree of disorder (turbulence) of the flow. For small anode currents the electron cloud is hottest close to the anode, where the temperature sometimes exceeds 10^7°K. For appreciable anode currents the hottest part of the cloud is absorbed by the anode and the average temperature is lowered. The effect of various parameters on the statistical characteristics of the velocities and the temperature is considered. The results can be useful in investigating the energy interchange between the stream and the field. The methods can also be used to investigate plasma statistics. (auth)

11618 STEADY-STATE ACCELERATION OF IONS TO 2 TO 20 keV IN A NONISOTHERMAL PLASMA. Kuznetsov, V. V.; Semashko, N. N. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 12, 2027-2028(Jun 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 12, 2609-2611(Dec 1972).

The axial and transverse electron energy spectra show that despite the absence of binary collisions, when oppositely directed electron beams pass through a plasma in a magnetic field, almost complete randomization of the beam electrons occurs. This leads to the appearance of an ion-accelerating electric field in a plasma in a magnetic nozzle in the presence of an electron beam. Ion currents up to 10 A are obtained at energies up to 20 keV. (auth)

11619 ENERGY LOST BY AN ELECTRON BEAM IN INTERACTION WITH A PLASMA. Boyd, D. (Stevens Inst. of Tech., Hoboken, NJ); Carr, W.; Jones, R.; Seidl, M. Phys. Lett., 45A: No. 5, 421-422(22 Oct 1973).

Measurements of the electron beam distribution function after the beam has interacted with a plasma indicate that a large fraction of the energy lost by the beam has been absorbed by the plasma. Only a small fraction is in the wave field. (auth)

11620 TOROIDAL EQUILIBRIA OF FUSION PLASMA IN A CURVED THETA PINCH. Cantrell, E. L. Austin, TX; Univ. of Texas (1973). 129p. University Microfilms Order No. 73-25,985. Thesis (Ph.D.).

The engineering problems associated with stabilizing the plasma drift due to the magnetic field gradient in a toroidal theta pinch are studied analytically and experimentally. The analysis is developed from the Lagrangian formulation for a dynamic circuit model. Stabilization by axial currents is realized from the formulation and agrees with reported experimental results. The formulation is applied to the equilibrium system utilizing auxiliary helical fields of l-fold symmetry. The analysis includes image currents which are spatially periodic due to varying coil-to-wall spacing. The periodicity leads to an asymmetry in the vertical plane resulting in a destabilizing vertical force on the plasma column. A modified helical system with an axisymmetric field period twice that of helical field is proposed. Analysis demonstrates that this eliminates the undesired vertical force while preserving the horizontal force needed for equilibrium. Experiments with a curved-30 kJ theta pinch having a major toroidal radius of 1.25 meters and an aspect ratio of 250 are reported. Toroidal drift measurements indicate that plasmas having β = 0.8 and T = 1.2 keV are produced. Streak photographs of the implosive phase show radial oscillations of 2 to 10 MHz. This agrees with theory for 100% mass collection during the implosion. A helical plasma excursion of approximately 1.10 is produced by a 70-kA, l = 1 helical current applied to external windings. An axisymmetric excursion of approximately 0.21 is produced by inserts in the θ-pinch coil. A vertical acceleration is observed as predicted by the analysis. Framing photographs at 50 nanosecond intervals indicate growth rates of the m = 1 instability of 0.5 to 2.0 MHz. Experimental parametric studies of the m = 1 growth rate give results which agree with theory. A radically different helical equilibrium scheme in which the helical plasma excursion is produced by a weak helical bias field is experimentally investigated. Helical bias currents of 10 to 15 kA are shown to give an equilibrium in the toroidal plane. No vertical acceleration is observed. Considerable asymmetry of the implosion is observed in streak photographs. This different method requires only 3% of that energy needed for the conventional method. Experiments are reported for the modified helical equilibrium suggested by the analysis. An equilibrium in the horizontal plane is achieved. The undesired vertical force is eliminated in accord with the analytic prediction. (Diss. Abstr. Int., B)

11621 CONCERNING THE NATURE OF BALL LIGHTNING. Stakhanov, I. P. JETP Lett. (USSR) (Engl. Transl.); 18: No. 3,

114-116(5 Aug 1973).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 193-196(5 Aug 1973).
It is proposed that recombination in ball lightning is delayed by formation of solvate shells around the ions in the gas phase. Estimates are presented of the surface tension of the lightning matter and of its stability. (auth)

Kinetics (Experimental)

11622 NEGATIVE THETA-PINCH EXPERIMENT. Akiyama, R.; Sato, K.; Kawakami, I.; Uchida, T. (Nagoya Univ., Japan). Phys. Lett., 45A: No. 5, 411-412(22 Oct 1973).
Plasma temperature obtained with a negative theta-pinch experiment is somewhat lower than that with an ordinary theta-pinch. This is consistent with a numerical calculation assuming Sagdeev resistivity. (auth)

11623 DEPENDENCE OF THE PARAMETERS OF A PLASMOID OBTAINED FROM A COAXIAL SOURCE ON THE POLARITY OF THE CENTRAL ELECTRODE. Belikov, A. G.; Goncharenko, V. P.; Goncharenko, D. K.; Derepovskii, N. T. (Physical Technical Inst., Kharkov). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 12, 1938-1940(Jun 1973).
Translated from Zh. Tekh. Fiz.; 42: No. 12, 2486-2489(Dec 1972).
It is shown that many parameters of the plasmoid—total number of particles, velocity, total energy, number of impurities, distribution of the energy density in space, and the energy distribution of the ions—depend strongly on the polarity of the central electrode. Some arguments are put forward to explain this dependence. (auth)

11624 HETEROGENEOUS ELECTRON BEHAVIOUR IN A TURBULENT PLASMA JET. Demetriades, A.; Doughman, E. L. (Philco-Ford Corp., Newport Beach, CA). J. Plasma Phys.; 9: 367-375(Jun 1973).
Uncommonly large electron density fluctuations, accompanied by large skewness and flatness factors, have been observed in the transitional zone of a plasma jet. These effects are investigated further by a digital analysis of Langmuir probe signals from this zone. The electron aggregate is found split into a decaying laminar-fluid remnant and a growing population of turbulent fluid. The uncommon statistics are caused by the double-humped histogram, while those of each population separately are normal. The mean electron density of the aggregate displays no simple chemical decay trend, but that of the laminar population fits known argon recombination schemes. (auth)

11625 POSSIBLE MECHANISM OF BREAKING THE CURRENT SHEATH IN A NONCYLINDRICAL Z PINCH. Bazdenkov, S. V.; Gureev, K. G.; Filippov, N. N.; Filippova, T. N. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 118-119(5 Aug 1973).
Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 199-201(5 Aug 1973).
In a number of experiments devoted to the "plasma focus" in the "MG" apparatus it was observed that, when working with a mixture of deuterium with a heavy gas (e.g., 0.3 to 1% Xe), the current sheath is disrupted ("breaks") in the anode region as it moves towards the axis of the chamber. The current sheath breaks at relatively large distances (8 to 15 cm) from the axis, commensurate with the anode diameter. The deuterium pressure in these experiments is 0.3 to 1 torr, the discharge current at the instant of the break is ~1 mA, and the capacitor-bank voltage is 16 to 18 kV. A figure shows scans of the discharges in pure deuterium and with Xe admixture, obtained through a slit perpendicular to the camera axis. The instant of the break of the current front, corresponding to a sharp rise in the radial velocity (up to ~10^8 cm/sec) is clearly seen. The "snow-plough" mechanism ceases to operate after that instant, and the current is compressed towards the axis without the increase in the plasma density in the focal zone. Conditions are then produced for the formation of a strong electron beam, generated at the expense of the magnetic-field energy stored in the chamber. Such discharges (without a dense pitch registered with a pinpoint camera in soft x radiation) are usually accompanied by a fragmentation damage to the central part of the anode and by intense x rays. (auth)

Kinetics (Theoretical)

11626 (CEA-CONF-2381) SUPERKINETIC EQUATION FOR NONUNIFORM SYSTEMS IN A TIME-DEPENDENT EXTERNAL FIELD. Exact Equation for Strong Collisional Plasma Turbulence. Balescu, R.; Misguich, J. H. (Brussels Univ. (Belgium); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. 4p. (CONF-730906-6). Dep. NTIS (U. S. Sales Only) $3.00.
From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).
A formalism showing the existence of a subdynamics is presented to provide a general superkinetic equation for systems in a time-dependent external field, which is an exact equation in usual experimental conditions. With a stochastic field, this equation constitutes the basis of a general strong plasma turbulence theory. When linearized in the mean external field, this equation allows the study of the mean linear response to a fluctuating external field, and thus constitutes the necessary tool for the study of turbulent resistivity in plasmas. (MOW)

11627 (IAE-2232) COLLISIONAL ELECTRON BROADENING OF STARK SUBLEVELS OF AN ATOM OF HYDROGEN IN A PLASMA. Sholin, G. V.; Demura, A. V.; Lisitsa, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
A theoretical examination was made of the contours of the hydrogen lines in plasma, excited as a result of the static interaction of ions and collisional electrons with consideration of the special characteristics connected with the presence of supplementary degeneration in the Coulomb field. General expressions were obtained for the half-width of the Stark component of every line of the hydrogen spectrum in parabolic coordinates. A subsequent analysis was carried out of the transition from the overlapping of the Stark component to the isolated lines. It was found that such a transition is accompanied by annulment of the nondiagonal matrix elements of the operator of the collisional electron broadening. The form of the interference member in the operator of the collisional electron broadening is corrected with consideration of the perturbation of the upper and lower levels. The calculations carried out made it possible to improve the agreement between theory and experiment for lines with strong central components. (tr-auth)

11628 (IPP-IV-58) CALCULATION OF FREE–FREE RADIATION FROM PLASMAS WITH NON-MAXWELLIAN ISOTROPIC OR ANISOTROPIC ELECTRON VELOCITY DISTRIBUTION. Eidmann, K. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.
Calculations of the bremsstrahlung resulting from electron–ion collisions in plasmas with non-Maxwellian electron velocity distributions are made with special regard to laser-produced plasmas. The quantum-mechanical theory was used with restriction to nonrelativistic electron energies and a pure Coulomb potential of the ions within the plasma. Results for the spectrum, the angular dependence, the intensity, and the polarization of the emitted bremsstrahlung for some examples of non-Maxwellian isotropic and anisotropic electron velocity distributions are presented. (auth)

11629 (IPPCZ-157) CONDITIONS OF ABSORPTION OF MICROWAVE ENERGY IN A PLASMA AT HIGH POWERS AND STRONG MAGNETIC FIELDS. Musil, J.; Zacek, F. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Oct 1971. 7p. INIS.
The linear theory states that, in an infinite inhomogeneous magnetoactive plasma at magnetic fields $\omega_{ce}/\omega > 1$, (1) the extraordinary wave can be absorbed only, and (2) the absorption takes place when the electron plasma density has a value given by the condition $(\mu - 1/\mu\omega_e^2\alpha - 1) > |$ where $\mu = \omega_{ce}/\omega$ is the angle of the direction of the wave propagation and the direction of the magnetic field B_0. These conclusions were experimentally verified. It was proved that only a right-hand circularly polarized wave, i.e., the extraordinary wave, can be absorbed in an inhomogeneous magnetoactive plasma with magnetic fields $\omega_{ce}/\omega > 1$. The magnitude of the wave power was found to affect the conditions under which the wave energy begins to be absorbed. The beginning of the absorption of the extraordinary wave at high powers was found to be determined by nonlinear effects. (auth)

11630 (JINR-P11-7299) COMPUTER SIMULATION PROGRAM OF FLAT CHARGED-LAYER BEHAVIOR IN AN EXTERNAL FIELD BY THE FINITE-SIZE PARTICLE METHOD AND USING THE DISPLAY FOR RESULT REPRESENTATION. Gazetova, A. M.; Zhidkov, E. P.; Karlov, A. A.; Katyshev, Yu. V.; Ososkov, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
A computer simulation program was compiled and tested for investigation of finite-size particle system behavior. The method of using a graphical display was developed for the representation of simulation results in the convenient form. (auth)

11631 (LA-5448-MS) NOTE ON THE CALCULATION OF ENERGY DEPOSITION OF ALPHA PARTICLES IN A DT PLASMA BY RUTHERFORD SCATTERING. Evans, F. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $4.00.

The approximations involved in computing range energy deposition of alpha particles in a DT plasma are discussed, and some numerical results are given. (auth)

11632 (LRP-67-73) KORTEWEG–DE VRIES EQUATION FOR A TWO-COMPONENT PLASMA. Tran, M. Q.; Hirt, P. J. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Sep 1973. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

A Korteweg–de Vries equation for a two component-plasma with cold ions ($T_i = 0$ for both species) and isothermal electrons is derived. The amplitude of the solitons is reduced drastically by a few percent of light ions, and an initial perturbation breaks up into more solitons than in a one-component plasma. (auth)

11633 (ORNL-TM-4421) ASSESSMENT OF THE POWER BALANCE IN FUSION REACTORS. Nozawa, M.; Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 105p. Dep. NTIS $7.25.

A general formalism is developed for analysis of the energy balance in fusion reactors. This formalism is applied in a detailed and consistent fashion to four current D–T fusion reactor concepts, the laser fusion, the mirror, the theta pinch, and the tokamak reactor concept. On the basis of a critical examination of the reactor subsystems, sets of reference parameters are adopted for each concept. The plasma performance is cast in terms of an energy multiplication factor, Q, defined as the ratio of the fusion produced energy (including blanket energy release) to the plasma energy at ignition. The Lawson number, $n\tau$, and the fractional burnup, f_b, associated with a given Q are derived on the basis of assumed values for the plasma ignition and burning temperatures. The values of Q, $n\tau$ and f_b required for power break-even and for net-power production at a given value of the overall plant efficiency, η, are then calculated for each concept using the reference parameters. The sensitivity of the required Q values to variations from the reference points is examined extensively. The plant energy-handling requirements are characterized by two parameters that are useful criteria in economics assessments; the ratio of the supply energy to the net-output energy, S, and the ratio of the circulating energy to the net-output energy, C. The behavior of S and C was examined for each concept. (auth)

11634 THIRD-ORDER NONLINEAR SATURATION EFFECTS IN A LONGITUDINAL BEAM–PLASMA SYSTEM IN THE ONE-DIMENSIONAL CASE. Chakraborti, N. B. (Indian Inst. of Tech., Kharagpur); Basu, P. N. Indian J. Pure Appl. Phys.; 11: No. 4, 235-237(Apr 1973).

A third-order nonlinear theory, neglecting thermal distribution and collisions of the plasma electrons, is developed for a longitudinal, one-dimensional beam–plasma system. A study is made of the saturation of the fundamental at large input levels. The input level at which the fundamental current density would reach maximum is found for a typical practical situation. (auth)

11635 KINETIC EQUATIONS FOR A NONIDEAL GAS AND NONIDEAL PLASMA. Klimontovich, Yu. L. (Moscow State Univ.). Usp. Fiz. Nauk; 110: No. 4, 537-568(Aug 1973). (In Russian).

Recent experimental studies of kinetic processes in dense gases and plasma have stimulated the development of the theory of nonideal gases and plasma. At present the kinetic theory of nonideal monoatomic gases of average density, and the kinetic theory of a weak, nonideal, completely ionized plasma have been developed. This review deals with a systematic presentation of these questions. The kinetic theory of nonideal gases of low density is constructed on the basis of the generalized, kinetic Boltzman equation (on the approximation of paired collisions), and of the Ulenbek kinetic equation (on the approximation of ternary collisions). The kinetic equations for denser gases have a substantially different structure than the ordinary kinetic equations. This difference is related to the impossibility of using the usual scheme because of the divergences in the collision integrals at higher approximations in density. The article presents the kinetic theory of a weak nonideal plasma. Particular attention is devoted to investigations of the possibilities of constructing classical and quantum kinetic equations without assumptions on the smallness of the particle interaction at small distances, since in a nonideal plasma the particle interaction at small distances plays a substantial role. A significant place in the review is devoted to presenting the kinetic theory of fluctuations in nonideal gases and plasma. A number of problems of the kinetic theory of nonideal systems are considered. (70 references) (SJR)

11636 COLLISION TERM FOR HOMOGENEOUS PLASMA IN MAGNETIC FIELD. Lapshin, V. I.; Stepanov, K. N. Kharkov State Univ.). Teor. Mat. Fiz.; 17: No. 2, 283-292(Nov 1973). (In Russian).

A collision term for homogeneous plasma particles interacting with each other according to the Coulomb law is obtained by the Bogolyubov method. The effect of a constant magnetic field on binary collisions and scattering of particles on plasma fluctuations is taken into account for a general nonstationary distribution function. The distribution function depends on perpendicular and parallel components of the momentum as well as on the azimuthal angle in the momentum space (with the z-axis parallel to the direction of the magnetic field). (auth)

11637 SIMILARITY TRANSFORMATION FOR THE COMPRESSIBLE JEFFERY–HAMEL FLOW OF DISSIPATIVE PLASMAS. Wilhelm, H. E. (Colorado State Univ., Fort Collins). J. Math. Phys. (N. Y.); 14: No. 10, 1430-1433(Oct 1973).

A similarity transformation is presented which transforms the nonlinear, partial differential equations describing a compressible plasma flow across an azimuthal magnetic field between plane inclined walls (Jeffery–Hamel flow with viscous momentum transfer, Ohmic and viscous heating, and thermal heat conduction) into one linear and two nonlinear ordinary, coupled differential equations. By elimination, the nonlinear boundary-value problem of this compressible plasma flow is reduced to a boundary-value problem for (i) two ordinary, coupled differential equations or (ii) a single functional integro-differential equation. The characteristic parameter "m" of the similarity transformation is shown to be an eigenvalue of the nonlinear boundary-value problem. (auth)

11638 RELAXATION TO EQUILIBRIUM OF A TWO-DIMENSIONAL PLASMA. Yoo, M. Y.; Abraham-Shrauner, B. (Washington Univ., St. Louis). Physica; 68: No. 1, 133-145(15 Aug 1973).

The H function was calculated numerically as a function of time for two cases, a heavy two-dimensional test particle in brownian motion and a negatively charged test particle in a two-dimensional background plasma of negative field particles of identical type. The H function is found to decrease monotonically in time for both cases. The relaxation time for $H = -2.7$ agrees quite well with the PIC results for a negatively charged test particle. Certain theoretical results for kinetic equations and H theorems are presented. (auth)

11639 SHIELDING OF MOVING TEST PARTICLES IN WARM, ISOTROPIC PLASMA. Chen, L.; Langdon, A. B.; Lieberman, M. A. (Univ. of California, Berkeley). J. Plasma Phys.; 9: 311-324(Jun 1973).

Shielding of test charges in warm, isotropic electron and electron–ion plasmas is studied analytically and numerically. For a plasma with hot Maxwellian electrons and cold mobile ions, the potential due to a charge moving faster than the ion acoustic velocity has an ion acoustic Cherenkov cone. Ahead of the particle, the shielding is the usual electron Debye type with a modified longer shielding length. (auth)

11640 TRANSVERSE ELECTRON THERMAL CONDUCTIVITY FOR A PLASMA IN A MAGNETIC FIELD. Zhilinskii, A. P.; Liventseva, I. F. (Leningrad Polytechnic Inst.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 12, 2034-2036(Jun 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 12, 2616-2618(Dec 1972).

The transverse electron thermal conductivity of a decaying plasma was measured. The measurements were carried out in argon at pressures from 0.05 to 0.3 mm Hg and magnetic fields $H \leq 2000$ Oe. The experimental data were obtained under conditions such that the electron–ion collision frequency exceeds the collision frequency of electrons with neutrals. Single probes were used to indicate the increments of the electron temperature. The measured quantities are compared with the results of a calculation based on collisional transport theory. (auth)

11641 APPROXIMATE CALCULATION OF THE ELECTRICAL CONDUCTIVITY OF A PLASMA. Schirmer, H.; Stober, I. (Osram GmbH-Studiengesellschaft, Munich). Z. Naturforsch.; 28a: No. 9, 1454-1458(1973). (In German).

In order to calculate the electric conductivity of a plasma, an approximate formula is derived, based on an improvement of the expression corresponding to a Lorentzian gas. The deviation from the exact solution (which is based on the Boltzmann equation of a plasma) is in most cases lower than 5% and will exceed this deviation only in exceptional cases. The calculations are performed for xenon and neon. (GE)

Production

11642 (SLA-73-5700) BEHAVIOR OF SOLID TARGETS IRRADIATED BY FOCUSED RELATIVISTIC ELECTRON BEAMS. Clauser, M. J.; Toepfer, A. J.; Freeman, J. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 22p. (CONF-731009-5). Dep. NTIS $3.25.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

With the demonstration that high ν/γ electron beams can be focused to produce fluxes of at least 10^{12} W/cm^2, one of the barriers in the way of electron-beam-initiated fusion in solid targets is greatly reduced. Several schemes are considered in the design of e-beam fusion pellets; the simplest pellet is a D–T droplet. This scheme requires that the beam energy be deposited in the outer portion of the droplet by an anomalous range-shortening mechanism, and also requires that the pulse be rather precisely tailored so that the majority of the energy arrives during the last fraction of a nanosecond. More complex targets have been suggested by several authors. For example, at the Moscow conference, Rudakov proposed using a pellet consisting of a high-density hollow shell containing DT gas. The pellet is irradiated by a single electron beam that passes through the entire pellet, heating the shell uniformly. The shell then implodes into the DT gas, compressing and heating it. These suggestions are discussed. (MOW)

11643 (SLA-73-5704) ELECTRON BEAM INITIATION OF PULSED FUSION. Yonas, G. (Sandia Labs., Albuquerque, N.Mex. (USA)). 1973. 19p. (CONF-731009-7). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

A brief review of world-wide research on electron-beam-initiated fusion is given. Most of the problems concerning the electron beam sources are mentioned. The possibilities of developing new sources for this work are described. (MOW)

11644 (UCRL-50021-73-1) LASER-FUSION PROGRAM. Semiannual Report, January–June 1973. Sussman, S. S. (ed.). (California Univ., Livermore (USA). Lawrence Livermore Lab.). 22 Aug 1973. Contract W-7405-eng-48. 249p. Dep. NTIS $7.60.

Brief discussions are given for each of the following areas of research covered during this report period: solid-state laser program, design analysis, component development, diagnostics, gas lasers, chemical lasers—the iodine laser, basic studies and advanced concepts, laser propagation, laser plasmas, laser fusion, isotope separation, and program resources. (MOW)

Stability

Refer also to abstract 10036.

11645 (N-73-29753) RATE EFFECTS ON INSTABILITIES IN SLIGHTLY IONIZED PLASMAS. Harstad, K. G. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 15 Jul 1973. Contract NAS7-100. 22p. (NASA-CR-133599; JPL-TM-33-642). NTIS $3.25.

Results are presented of numerical computer calculations of dispersive wave growth rates in slightly ionized plasmas. The effects of employing a plasma model with detailed consideration of rate and radiative processes involving the electron quantum states were studied. Acoustic and electrothermal waves in unseeded argon are found to be frozen with the latter damped. Rate thermal modes can exhibit large growth. Mode mixing and switching in both seeded and unseeded argon are demonstrated. (auth)

11646 INSTABILITY OF A NARROW ELECTRON BEAM INTERACTING WITH A PLASMA. Makeev, V. S. Zh. Eksp. Teor. Fiz.; 65: No. 4, 1448-1453(Oct 1973). (In Russian).

Instability of an electron beam in a low-density magnetized plasma was investigated experimentally. A special feature of the experiments was the low cross section of the beam (3×10^{-2} cm), this being an extremum condition for the observation and identification of plasma instabilities of the drift type. The "anomalous" plasma diffusion phenomenon, which appears during development of the instability, is investigated. Comparison of the experimental results with the theory shows that, under the experimental conditions investigated, escape of ions from the beam is due to their acceleration across the magnetic field by axial-nonsymmetric electron–ion oscillations; the latter develop in the beam on consecutive kinetic and hydrodynamic buildup of drift-beam instability. (auth)

11647 INSTABILITIES DUE TO NEGATIVE-PRESSURE EFFECTS. Yu, M. Y.; Shukla, P. K. (Ruhr-Univ., Bochum, Ger.). Phys. Lett., 45A: No. 5, 415-416(22 Oct 1973).

The presence of a negative-pressure component in a plasma causes low-frequency electrostatic ion waves to become unstable if the number density of that component is sufficiently high or its temperature sufficiently low. (auth)

11648 FRICTIONAL EFFECTS WITH NEUTRALS AND THE GRAVITATIONAL INSTABILITY OF A PLASMA. Bhatia, P. K. (Jadavpur Univ., Calcutta). Publ. Astron. Soc. Jap.; 24: No. 3, 375-379(Jul 1972).

The gravitational instability of a plasma was studied, taking into account the frictional effects with neutrals. The effects of finite conductivity and Hall currents were also included. It was found that Jeans' criterion remains unchanged in the presence of finite conductivity, Hall currents, and frictional effects with neutrals. (auth)

11649 THERMAL INSTABILITY AND CONTROL OF INHOMOGENEOUS PLASMA IN A D–T FUSION REACTOR. Ohta, M.; Yamato, H.; Mori, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 353-359(Jun 1973).

When a D–T fusion reactor is operated in steady state, the core plasma deviates from equilibrium below a critical temperature. This instability has been analyzed when the plasma is distributed uniformly. In nonuniform plasmas, however, the stability is not yet known. The stability of a radially nonuniform plasma is discussed analytically, assuming cylindrical symmetry. As a result, it is made clear that the stability of a nonuniform plasma is essentially the same as that of a uniform plasma, and that the critical temperature is determined by the dependence of the diffusion rate and the thermal conduction on the plasma density and temperature. When the diffusion rate is independent of the density and temperature, the critical temperature is higher than that in Bohm diffusion and lower than in classical diffusion. When a reactor is operated in an unstable region, feedback control is indispensable. The possibility of stabilization is discussed when the feedback is applied to the plasma density or temperature with different periods of delay after monitoring the peak temperature deviation from equilibrium. The instability and its control are also analyzed numerically. The analytical results are in a good agreement with computer calculations. (auth)

11650 INSTABILITIES OF DRIFT MAGNETOSONIC WAVES DUE TO MAGNETIC DRIFT RESONANCE. Ishihara, T. (Tokyo Univ.). J. Plasma Phys.; 9: 389-407(Jun 1973).

The drift magnetosonic waves in a finite-pressure plasma are considered. Instabilities arising from the magnetic drift resonance of particles with waves are investigated for two cases, quasi-perpendicular and oblique propagations. It is shown that, in a wide range of both the density and temperature gradients, these waves can be excited even in a high-beta plasma. (auth)

11651 DYNAMIC STABILIZATION OF HELICAL m = 1 INSTABILITY IN LINEAR SCREW PINCH. Gruber, O. Munich; Technische Univ. (1971). 55p. (In German).

Thesis.

The possibilities of a dynamic stabilization of the helical m = 1 instability of the linear screw pinch were investigated (ion temperature ~50 to 500 eV, maximum electron density ~5×10^{16} cm^{-3}, β approximately > 0.5). The growth rates (0.5 to 3×10^6 s^{-1}) and wavelengths (100 to 200 cm) measured for the pure screw pinch are in good agreement with theoretical models and with results obtained for a toroidal screw pinch. Two stabilization methods were investigated. The first method uses superposition of an hf field on the axial magnetic field, thus inducing forced m = 0, k = 0 oscillations in the plasma, leading to the stabilization of the m = 1 mode. The observed amplitude and frequency dependence of the stability indicates that stabilization occurs through inertia forces produced by the forced oscillations. Measurements with magnetic probes have shown that the shear of the magnetic fields is small and that their stabilizing effect is negligible. Achievement of stabilization conditions can be facilitated by a factor of two when working in resonance with the m = 0 natural oscillations of the plasma. In the second method, a hf current is added to the axial plasma current in order to study the stabilizing effect of a periodic shear of magnetic fields. Stabilization by inertia forces does not occur in this case, as the plasma radius remains constant. Probe measurements have shown that the hf currents in the z direction flow mainly outside the dense plasma in the pressure-free outer plasma. The measured penetration depths are considerably larger than the skin depth determined by classical collision processes. This agrees with the high values measured for the anomalous resistivity which leads to significant ohmic losses. (GE)

Thermonuclear Engineering and Equipment

Refer also to abstracts 10604, 10806, 10832, 10859, 12456, and 12467.

11652 (BNL-18236) STUDIES OF FUSION REACTOR BLANKETS WITH MINIMUM RADIOACTIVE INVENTORY AND WITH TRITIUM BREEDING IN SOLID LITHIUM COMPOUNDS: A PRELIMINARY REPORT. Powell, J. R.; Miles, F. T.; Aronson, A.; Winsche, W. E. (Brookhaven National Lab., Upton, N. Y. (USA)). Jun 1973. 130p. Dep. NTIS $8.50.

The feasibility of fusion reactor blankets with low residual activity is examined. Several designs are examined with regard to activation, tritium breeding ratio, mechanical design, tritium removal from the blanket, and thermal cycle efficiency. Using aluminum (SAP) as a structural material, it should be possible to build CTR blankets with ~10 curies/MW(e) of long-lived (half life one day or greater) residual activity (other than tritium), which is many orders of magnitude less than with Nb or stainless steel blankets. In the designs examined in this study, tritium is bred in solid-lithium-containing materials, e.g., LiAl alloy, which have high-equilibrium tritium pressures. The tritium diffuses into either the helium-coolant stream, from which it is removed by absorption, or into the vacuum region between the first wall and plasma. Depending on processing methods and blanket parameters, the tritium blanket inventory should range from 10^2 to 10^3 curies/MW(e). Tritium breeding ratios range from 0.9 to 1.5 depending on blanket design, while thermal cycle efficiency is estimated to range from 35% to well over 40%, depending on design. Several module designs are developed in which helium-coolant exit temperatures are substantially above the operating temperature limit (~400°C) for the aluminum (SAP) structure. (auth)

11653 (IAE-2246) PRELIMINARY CALCULATION OF THE PARAMETERS OF AN EXPERIMENTAL THERMONUCLEAR REACTOR BASED ON A TOKAMAK (ETRT). Popkov, G. N.; Strelkov, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii. 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of realization of a thermonuclear reactor (tokamak) with positive output during operation on mixtures of deuterium and tritium is discussed, with consideration of the possible nonideal thermal insulation of the plasma. For evaluation of the size of the energy loss from the plasma, experimental data on the degree of the thermal insulation of the plasma on the T-3 and TM-3 installations was extrapolated by different functional laws to the area of thermonuclear parameters. The calculations were carried out in the uniform distribution approximation according to the cross section of the plasma filament for all magnitudes describing the plasma. For different forms of the functional links between the stages of thermal insulation of the plasma in the tokamak and its parameters, the minimum values were found for the geometric dimensions and other parameters of the reactor with positive output. These values do not appear optimal in the sense of the cost of the energy produced and the size of the capital expenditure. It was found that, with use of only Joule heating of the plasma, difficulties arise associated both with creation of large magnetic fields (greater than 200 kOe, if $g = 2$) and with strong cyclotron radiation. In order to assure a positive energy balance, it is necessary to guarantee conditions under which the magnitude of the energy loss from the plasma filaments from electron-cyclotron radiation was reduced several tens because of repeated reflections from the walls. The use of positive methods of plasma heating makes it possible, within the framework of the accepted calculation model, to reduce the minimum necessary values of the magnetic field. Losses from cyclotron radiation in this case do not play a decisive role. (tr-auth)

11654 (IPP-2-215) STELLARATOR FIELDS WITH TWISTED COILS. Rehker, S.; Wobig, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Aug 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

The magnetic field of a set of circular and twisted coils is calculated. The number of coils is 16 or 12. It is shown that toroidal magnetic surfaces exist that meet the requirements for stellarator experiments. In the $l = 2$ system, the rotational transform can be increased to $t \approx 0.5$. The magnetic well depth of the configurations reaches values between 1 and 10%. In the $l = 3$ system, a rotational transform of $t \lesssim 0.3$ on the separatrix can be obtained. The change of the rotational transform with the variation of coil radius, twist of the coil, superposition of a toroidal field, and elliptic deformation of the coil is investigated. (auth)

11655 (IPP-4-101) NEUTRON FLUX ASYMMETRY IN TOROIDAL GEOMETRIES. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F.R. Germany)). Sep 1972. 46p. Dep. NTIS (U.S. Sales Only) $4.50.

On the premises of the plasma being a volumetric, homogeneous, and isotropic neutron source of toroidal shape, an evaluation of the primary neutron flux striking the first wall was performed. The first step in this calculation is the determination of the angular distribution, which can be obtained by either an iterative or an exact method. By numerically integrating this distribution the total flux is calculated as dependent on the position of a point at the small wall perimeter. Results are presented for a tokamak- and a stellarator-type geometry. They indicate that there is no reason to claim a reduction of the mean wall loading due to this effect. Moreover, it is concluded that an approximation model using a circular line source along the torus center line sufficiently fits the results gained by the exact procedure. (auth)

11656 (LA-UR-73-1612) PREDICTION OF FAILURES IN C.T.R. SYSTEMS. Boicourt, G. P. (Los Alamos Scientific Lab., N.Mex. (USA)). 1973. 6p. (CONF-731114-26). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The problem of predicting failure rates is becoming more important in C.T.R. engineering because of the large systems under consideration. A large theta-pinch system will contain thousands of identical components, many of which are barely beyond the development stage and whose failure rates may be fairly high. A typical "mean time between failure" calculation assumes all the components in the system are on the flat part of their failure rate curve. This means the early failure components have been eliminated before that particular group of components is installed in the system. Unfortunately, some of the critical components in a large theta-pinch system may not be tested sufficiently to reach the flat part of the failure rate curve because of the time and expense involved. When this occurs, a standard MTBF calculation will have little or no meaning. Since usually only a few types of components determine the failure rate in CTR systems it is possible to compute an analogous quantity, the "expected time to next failure," provided the failure distributions of the critical component types are known. A Monte Carlo method for the computation when failures are independent is described and examples are given. (auth)

11657 (LA-UR-73-1613) TRITIUM ION BEAM FOR AN INTENSE NEUTRON SOURCE, INS. Emigh, E. R. (Los Alamos Scientific Lab., N.Mex. (USA)). 1963. Contract W-7405-eng-36. 6p. Dep. NTIS $3.00.

The INS facility has been proposed to provide a neutronic environment similar to that anticipated in a fully operational fusion-power reactor. The neutron generator will produce an intense flux of 14-MeV neutrons > 10^{14} neutrons/cm^2 sec from the collision of two intersecting beams, one of 1.1 A of 270-keV tritium ions and the other of a supersonic jet of deuterium molecules. Using either the pure 14-MeV primary-neutron spectrum or by tailoring the spectrum with appropriate moderators, crucial radiation-damage effects can be explored and better understood. To obtain a multi-ampere tritium-ion beam for the INS, an ion source that can operate continuously with a high ion-current density over a very large plasma ion-extraction area is required. The ion source must be designed to provide a quiescent plasma that is uniform in density over a relatively flat extraction surface. Such extraction will assure a low beam emittance and manageable beam optics. An annular duoplasmatron is described that is designed to provide long-life reliability (>2000 hrs), a high gas efficiency (>20%), and high-quality beam generation (normalized emittance ~0.3 cm-mrad). The beam transport system, including an accelerating column, bending magnets, and quadrupole focusing magnets, must be designed to transport the tritium ions to a well-defined target area without loss of appreciable power (the beam contains ~⅓ MW). Because of radioactive hazards in the handling of the tritium, and to minimize the tritium inventory, the vacuum system for the ion source and beam transport must be capable of recycling the tritium using closed-loop techniques. (auth)

11658 (LBL-2425) NEUTRAL-BEAM RESEARCH AND DEVELOPMENT AT LBL, BERKELEY. Baker, W. R.; Berkner, K. H.; Cooper, W. S.; Ehlers, K. W.; Kunkel, W. B.; Pyle, R. V.; Stearns, J. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 11p. (CONF-731114-23). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The neutral-beam research and development effort at LLL has been concerned mainly with design, construction, and testing of ion sources needed in present and planned experiments, chiefly at LLL. Development of techniques for producing reactor-type neutral beam systems with higher voltage, current, and duty cycle proceeds as resources permit. An important part of this program is

the attempt to increase the physics understanding and technology needed for the design of beams with precisely controlled trajectories, e.g., converging beams. (auth)

11659 (N-73-28693) CHARACTERISTICS AND PERFORMANCE OF A SUPERCONDUCTING BUMPY-TORUS MAGNET FACILITY FOR PLASMA RESEARCH. Roth, J. R.; Holmes, A. D.; Keller, T. A.; Krawczonek, W. M. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 58p. (NASA-TN-D-7353; E-7225). NTIS $3.00.

The NASA Lewis bumpy-torus facility consists of 12 superconducting coils, each 19 cm i.d. and capable of 3.0 T on its axis. The coils are equally spaced around a toroidal array with a major diameter of 1.52 m; they are mounted with the major axis of the torus vertical in a single vacuum tank 2.6 m in diameter. Tests of the facility mapped out its magnetic, cryogenic, vacuum, mechanical, and electrical performance. The design value of the maximum magnetic field on the magnetic axis, 3.0 T, was reached and exceeded. A maximum magnetic field of 3.23 T was held for a period of 60 minutes. When the coils were charged to a maximum magnetic field of 3.35 T, the coil system went normal without apparent damage or degradation of performance. (auth)

11660 (ORNL-TM-4201) ADDITIONAL RESULTS CONCERNING CROSS-SECTION SENSITIVITY OF TRITIUM BREEDING IN A FUSION REACTOR BLANKET: ^{6}Li, ^{7}Li, AND ^{93}Nb. Tobias, M.; Steiner, D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

Previous work concerning cross-section sensitivity of the tritium breeding ratio showed the effects of altering a partial cross section independently of other partial cross sections, permitting the total cross section to rise or fall. The results reported here are mostly for variations made while keeping the total cross section constant. The cases considered were for high and low values of the cross sections for ^{6}Li(n,α)t, ^{7}Li(n, n'α)t, and for ^{93}Nb(n,2n) with compensatory changes in other cross sections. The general conclusions of previous work have been borne out both qualitatively and quantitatively under the present more realistic ground rules. In addition, results are reported for a modified CTR benchmark which has blanket material in place of the graphite reflector. This case shows a drop of 0.13 in ^{6}Li productions, a rise of 0.02 in ^{7}Li productions, and an increase of 0.15 in neutron leakage. (auth)

11661 FUSION NEUTRON ENERGIES AND SPECTRA. Brysk, H. (KMS Fusion, Inc., Ann Arbor, MI). Plasma Phys.; 15: No. 7, 611-617 (Jul 1973).

The interaction of two Maxwellian distributions of particles will differ from the interaction of the two particles at their respective Maxwell averages if the strength of the interaction varies significantly with energy over the widths of the distributions. This effect is considered in particular for fusion (both D–T and D–D) for the mean energy of the reacting particles as a function of temperature and for the spectrum of the neutrons produced. (auth)

11662 MEASUREMENT OF THE LEAKAGE MAGNETIC FIELD FROM THE IRON CORE IN A TOKAMAK DEVICE WITHOUT SHELL. Matsuda, S. (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 12: No. 6, 903-907 (Jun 1973).

The equilibrium of a plasma confined in shell-less tokamak devices is strongly influenced by the leakage magnetic field from the iron core. The strength of the vertical component of the leakage magnetic field is of the same order of magnitude as the equilibrating vertical field. A method of measuring such a leakage magnetic field in the presence of a simulated plasma current is described. Measurements are made by using a model core of a tokamak device (JFT-2). (auth)

11663 IMPROVEMENTS IN OR RELATING TO HEAT EXCHANGERS. Mitchell, J. T. D.; Booth, J. A. (to United Kingdom Atomic Energy Authority). British Patent 1,332,755. 3 Oct 1973. Filed date 28 Jun 1971. 6p.

Reference is made to heat exchangers of the evaporative or two-phase-flow type. The heat exchanger described, for vaporizing a liquid, comprises an elongated tube for conveying the liquid with one or more heat exchanger members located on its outside, the external surfaces of which are exposed to a source of heat sufficient to vaporize the liquid. The internal surfaces of these members are covered with a flow distributor layer in communication with the tube and having a number of capillary passages for constraining the liquid to contact the internal surfaces of the members. The interior of a member defines a chamber for collecting the vapor. Preferably, a member extends in a plane transverse to the axis of the tube, or the member may take the form of a helix extending around the tube. The liquid to be heated is fed to the flow distributor layer at a rate sufficient to keep it moist. The flow distributor layer may be made of porous or fluid permeable metal, ceramics, fibrous matting, or woven material, and the material need not necessarily be heat-conductive, since the layer functions as a flow distributor rather than an extension of the heat-exchange surface. An outer vessel for containing a heating medium surrounds at least part of the heat exchanger. An application of the system to a fusion reactor is described; the system may also be employed as a refrigerator in which the liquid to be vaporized is a cryogenic liquid. (UK)

Wave Phenomena

Refer also to abstracts 11109 and 11110.

11664 (FUPH-R-91) PROPAGATION OF COMPRESSIONAL ALFVEN WAVES IN NONUNIFORM PLASMAS. Morrow, R.; Brennan, M. H. (Flinders Univ. of South Australia, Bedford Park. School of Physical Sciences). Aug 1973. 35p. Dep. NTIS (U.S. Sales Only) $3.75.

A theoretical treatment is presented for the propagation of Alfven waves in a plasma including the effects of resistivity, ion–neutral collisions, the ion cyclotron frequency, and radial nonuniformities in ion density, neutral-particle density, and temperature. The theory is applied to plasmas with conducting and nonconducting walls and compared with results of experiments conducted in the afterglow of a shock-produced plasma. Nonuniformity in the ion density is found to have a marked effect on the dispersion relation and wave-field profiles. Nonuniformities in the total particle density and temperature are less important. Excellent agreement is obtained between theory and experiment, allowing unambiguous and accurate determinations to be made of the average total particle density, which is found to be ~50% of the initial filling density, and the cross section for momentum transfer between protons and hydrogen atoms. (auth)

11665 (LRP-62-73) PROPAGATION OF HYDROMAGNETIC WAVES OF AZIMUTHAL WAVE NUMBER $m \neq 0$ IN A CYLINDRICAL ARGON PLASMA. Peiry, J. M. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Mar 1973. 99p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis.

An experimental device for studying the propagation of the MHD waves was built. The electron density was measured by interferometry and the other plasma parameters by exciting the slow $m = 0$ mode, used as a diagnostic. Various antennas were designed and allowed to launch simultaneously the $m = \pm 1$ modes at low frequency and up to the vicinity of the ion cyclotron frequency. The magnetic configurations and the dispersion relations of these modes were established experimentally with the help of double magnetic probes. The confrontation of the experimental results with L. C. Woods' theory clearly showed the existence of a mode coupling due to the boundary conditions. The fundamental modes $m = +1$ and $m = -1$ then behave qualitatively as the right and left modes in an infinite medium. Furthermore, the influence of parameters such as the neutral density, the insulating wall thickness of the discharge tube, and the sign of the axial magnetic field on the propagation of these waves was checked. (auth)

11666 ELECTRON PLASMA WAVE SHOCKS IN A COLLISIONLESS PLASMA. Saeki, K. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 251-257 (Jul 1973).

A large-amplitude electron plasma wave in a bounded collisionless plasma is observed to steepen and form a shock with a trailing wave train. The dependence of the Mach number and the period of the wave train on the shock amplitude shows that the shock structure is related to solitary waves. For a larger-amplitude shock, however, the trailing wave train is small or disappears, and a potential jump followed by large-amplitude oscillations propagating with a slower velocity than that of the shock front is observed. The amplitude of the oscillations is sufficiently large to trap a significant number of electrons and to form vortices in phase space. (auth)

11667 MEASUREMENT OF THE EVOLUTION IN PHASE SPACE OF AN ELECTRON BEAM INTERACTING WITH A PLASMA. Carr, W.; Boyd, D.; Jones, R.; Seidl, M. (Stevens Inst. of Tech., Hoboken, NJ). Plasma Phys.; 15: No. 8, 826-829 (Aug 1973).

Results are presented of a measurement of the locus of beam electrons referenced to energy position and curve phase. The experiment followed a recently proposed model of cold beam–plasma interaction until saturation, when the wave decayed and the particles became untrapped at a velocity smaller than the wave velocity. (UK)

11668 STRUCTURE OF SHOCK WAVES IN A PLASMA IN WHICH RADIATION PLAYS THE DOMINATING ROLE. Zel'dovich, Ya. B.; Illarionov, A. F. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1294-1302(Oct 1973). (In Russian).

The structure of a shock wave (SW) propagating in a plasma in which the electromagnetic radiation density exceeds the nuclear and electron density is considered. The relations between the plasma parameters before and behind the SW front are found. The radiation directly behind the SW front has a nonequilibrium spectrum and interacts with the rarefied matter by the Compton mechanism. After multiple scattering (if $kT \ll m_e c^2$) by electrons, the radiation spectrum becomes a Bose–Einstein equilibrium one and is characterized by a quantum density deficiency compared to that for blackbody radiation. The photon deficiency is compensated by bremsstrahlung emission and absorption processes. A thermodynamically stable radiation spectrum is formed as a result of the combined action of bremsstrahlung and Compton processes at considerable distances from the SW front. (auth)

11669 WAVE TRANSFORMATION IN AN INHOMOGENEOUS UNSTABLE PLASMA. Erokhin, N. S.; Moiseev, S. S. (Physical Technical Inst., Kharkov). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1431-1447(Oct 1973). (In Russian).

Linear transformation of beam space-charge waves and of magnetoactive plasma oscillations by influencing density inhomogeneities is investigated. It is shown that amplification of plasma oscillations by a beam occurs either in the presence of a nonlinear longitudinal plasma density gradient or at the expense of transverse inhomogeneity. Anisotropy of transverse wave emission by a charge in a magnetoactive plasma with a smooth longitudinal density inhomogeneity is observed. (auth)

11670 EXCITATION OF TRANSVERSE EXTRAORDINARY MODEL IN AN INHOMOGENEOUS MAGNETOPLASMA. Hiroe, S. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 35: No. 1, 244-250(Jul 1973).

The extraordinary waves in an inhomogeneous magnetoplasma are studied. These waves are excited between the upper hybrid ($\omega_p^2(r) = \omega^2 - \omega_c^2$) and the left hand cutoff ($\omega_p^2(r) = \omega^2 + \omega\omega_c$) frequencies. The extraordinary waves propagate from the left hand cutoff point to the upper hybrid point perpendicularly to the static magnetic field lines of forces, so that the extraordinary waves are not excited near the upper hybrid but near the cutoff frequency. (auth)

11671 ANALYSIS OF THE TRANSMISSION AND REFLECTION OF AN ELECTROMAGNETIC WAVE AT A PLASMA BOUNDARY: REDUCTION TO A HILBERT BOUNDARY PROBLEM AND ITS SOLUTION. Mason, D. P. (Univ. of the Witwatersrand, Johannesburg). Physica; 68: No. 1, 183-194(15 Aug 1973).

The problem of transmission and reflection of a plane electromagnetic wave incident normally on a plasma half-space is considered. The Laplace transformation technique applied so successfully by Özizmir to the specular reflection boundary condition is extended to deal with the diffuse reflection boundary condition. The problem is reduced to the consideration of a nonhomogeneous Hilbert boundary problem which is then solved. The present solution for the electromagnetic field in the plasma and vacuum agrees with that already obtained using an eigenfunction expansion technique. (auth)

11672 MAGNETOGASDYNAMIC SHOCK POLAR: EXACT SOLUTION IN ALIGNED FIELDS. Bertram, L. A. (Iowa State Univ. of Science and Tech., Ames). J. Plasma Phys.; 9: 325-347(Jun 1973).

The shock conditions for a perfect gas in aligned-fields magnetogasdynamics are solved to give all variables downstream as rational functions of the density ratio. The thermodynamically admissible, evolutionary shock solutions are classified into seven shock polar types, including a new type of supersonic, sub-Alfvénic polar. Example polars of each type are presented in the magnetograph (dimensionless magnetic induction vector plane) and in the Taniuti–Resler diagram (M, A plane) to display, respectively, the shock geometry and the state of the gas. A short discussion of the relation of the shock properties to flow over bodies is presented. (auth)

11673 WAVE PROPAGATION IN A PARTIALLY IONIZED CHEMICALLY REACTING PLASMA. Fang, T. M.; Baum, H. R. (Harvard Univ., Cambridge, MA). J. Plasma Phys.; 9: 349-365 (Jun 1973).

Multifluid equations are used to study small-amplitude wave motion in a partially ionized chemically reacting plasma. The plasma is assumed to be infinite and without external fields. The dispersion equations are derived and solved both numerically and analytically for several limiting cases. The effects of chemical reactions were explicitly obtained. It is found that at the long-wavelength limit, the ionization and recombination terms play the dominant role for the damping of certain longitudinal waves even for a nearly frozen plasma. (auth)

11674 MODIFIED KORTEWEG–DE VRIES EQUATION FOR ION ACOUSTIC WAVES DUE TO RESONANT ELECTRONS. Schamel, H. (Max-Planck-Institut fuer Physik und Astrophysics, Munich). J. Plasma Phys.; 9: 377-387(Jun 1973).

The dependence of the asymptotic behavior of small ion-acoustic waves on the number of resonant electrons is investigated by assuming an electron equation of state corresponding to the observed flat-topped electron distribution functions. The result is a modified Korteweg–de Vries equation with a stronger nonlinearity. (auth)

11675 CHARACTERISTICS OF FAST AND SLOW MAGNETOSONIC WAVES IN LAYERED PLASMAS. Tamao, T. (Tokyo Univ.). J. Plasma Phys.; 9: 429-442(Jun 1973).

Propagation characteristics of two magnetosonic waves, the fast and slow modes, in layered plasmas with different beta values are studied, where beta is the ratio of plasma pressure to magnetic pressure. The efficiency of wave penetration from one region to another with different ratios is considered. In particular, the condition for the total reflection, amplitude, and phase of the reflection and transmission coefficients at the interface are obtained for both modes. In addition, the fast and slow normal modes of magnetosonic waves in layered plasmas are discussed and their phase and group velocities, and the spatial damping rate due to partial leakage of wave energy are compared between two modes. (auth)

11676 NONLINEAR PROPAGATION OF ELECTROMAGNETIC WAVES IN A PLASMA CONTAINING RANDOM IRREGULARITIES. Liu, C. H. (Univ. of Illinois, Urbana). J. Plasma Phys.; 9: 443-452(Jun 1973).

The problem of propagation of finite-amplitude electromagnetic waves in a plasma containing random irregularities is studied. Using a recently developed perturbation technique, a general equation for finite-amplitude coherent waves is derived. Included in this equation are both the effects of quasi-harmonic nonlinear heating of electrons and random scattering by irregularities. The equation is solved in general by the equivalent linearization procedure. The amplitude of the coherent wave is found to be attenuated by collision and scattering. Both attenuations are affected by the nonlinear heating of the electrons. Curves showing the results for a specific example are presented. (auth)

11677 COLLISIONAL DAMPING OF AN IMPULSIVE PLANE WAVE INCIDENT ON AN ANISOTROPIC PLASMA HALF-SPACE. Stanic, B. V.; Skoric, M. M. (Univ., Belgrade). J. Phys., D (London); 6: No. 16, L115-L117(26 Oct 1973).

The time-dependent transmitted and reflected waveforms for an impulsive plane wave incident normally on an anisotropic lossy plasma half-space are computed by the use of an inverse Fourier transform. The amplitudes of the parallel and cross-polarized components of electric field are noticeably damped, while the period of oscillatory response is practically independent of collision frequency. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 9763, 10224, 10241, 10424, 10504, 10819, 10881, 11159, 11483, and 11486.

11678 (BNWL-SA-4763) ELECTRON EJECTION CROSS SECTIONS FOR HYDROCARBON MOLECULES AND THEIR IMPLICATIONS FOR PHASE EFFECTS. Wilson, W. E.; Paretzke, H. G. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd] Contract AT(45-1)-1830. 10p. (CONF-730952-5). Dep. NTIS $3.00.

From fourth symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

The ultimate effect of a radiation on a biological material is strongly dependent upon the spatial and temporal distribution of the events produced by the particles of the radiation field. Measuring the distributions in condensed phase is impossible owing to the extremely fast time scale involved and the very short range of the secondary electrons and recoil ions. Evaluation of track structure in condensed phase must rely on measurements in gaseous phase. This raises the question, how valid are the fundamental parameters measured in gaseous phase for calculations in condensed phase? This problem will be discussed by analyzing the results of electron ejection experiments in gas phase. In an attempt to observe variations in the electron yield attributable to the molecular binding of the target atoms, cross sections, differential in ejection energy and angle, for electron emission from methane, ethane, ethylene, acetylene and benzene molecules following proton impact have been measured for protons of 0.3 and 1.0 MeV and from benzene for 2 MeV protons. The results for the five molecules indicate that there is no significant variation in the emission of electron with energy $\gtrsim$15eV within this group of molecules. Regardless of the chemical bonds, the cross sections for a given proton energy are proportional only to the number of outer electrons in the molecule. Since the perturbations due to intra-molecular bonding are insignificant in effecting the emission distributions of the secondary electrons ($E \gtrsim 15eV$) we conclude that the much smaller inter-molecular forces responsible for the differences between gaseous and condensed phase will likewise not significantly change these cross sections. Therefore, the cross sections measured for gaseous phase are useful and valid input parameters for proton track structure calculations. (auth)

11679 (CEA-CONF-2277) MACRODOSIMETRY: APPLICATIONS IN RADIOPROTECTION. De Choudens, H. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 16p. (In French). (CONF-720567-4). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh national congress on the monitoring of ionizing radiations conference; Marseilles, France (16 May 1972).

Microdosimetry is a new technique for radioprotection which is particularly useful and without competition for the dosimetry of mixed fields and high energy radiation beams. The utilization of a LET spectrometer in conjunction with high energy accelerators or for spatial dosimetry of particularly complex radiation compositions is discussed. The development of the microdosimeter has contributed to the alignment of physical measurements and biological observations of the damage caused and thus leads to a deeper understanding of the effects of radiation on tissues. (auth)

11680 (CEA-R-4532) DECHANNELING OF α PARTICLES BY HYDROGEN ATOMS IN PALLADIUM. Quillico, J. J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Dec 1973. 68p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Crystal defects, like interstitial atoms, induce an obstruction or a deformation of axial or planar channels. The result is a decrease in the number of channeled α particles. The intensity of this dechanneling effect depends on the defect concentration. The purpose of this study was to measure the dechanneling cross section of an hydrogen atom in palladium. The samples are loaded in gas by heating in a helium-hydrogen atmosphere and quenched at 77 K. Channeled α particles are recorded on a collector. After annealing hydrogen atoms out of the sample, at room temperature, another recording is done in the same conditions. The measure of the dechanneling yield, X, is made by means of an optical microdensitometry on both collectors. The measurements of X are performed for different hydrogen atomic concentrations C. The following expression: $X = 1 - \exp(-\sigma C e)$ has been found both theoretically and experimentally. Here e is the thickness of the sample and σ the dechanneling cross section of an hydrogen atom. The experimental value for σ is: $\sigma = 6.4 \pm 0.2 \times 10^{-3}$ Å^2. This value is very low which indicates that the dechanneling effect of hydrogen in palladium is of the obstruction type and that the strains around the defect have essentially no effect on dechanneling. (auth)

11681 (CONF-730952-7) MICROSCOPIC DESCRIPTION OF ENERGY DEPOSITION IN TISSUE BY PION BEAMS. Turner, J. E.; Hamm, R. N.; Wright, H. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 19p. Dep. NTIS $3.00.

From fourth symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

Direct experimental information about the results of the capture of stopped negative pions by oxygen and carbon nuclei is scant. The Monte Carlo computer program, PION-1, has been developed to provide the needed data. The spatial distribution of the dose in a water target calculated from PION-1 is in good agreement with that measured in a typical experiment. This program transports each primary particle in a pion beam (i.e., pion, muon, or electron) individually until it interacts, leaves the target, or stops. Multiple scattering and range straggling are included. For each interaction the program produces a set of secondary particles (protons, neutrons, alpha particles, recoil nuclei, etc.), which it also transports. From the complete microscopic picture thus generated, the dose from each type of particle, the LET distributions, etc. can be tabulated in any desired manner. PION-1 was used to obtain such information for tissue targets irradiated by pion beams. The breakdown of the components of dose in various volume elements within the beam (in the plateau and in the peak) and outside the beam was calculated. A discussion is given of the details of the nature of the dose in these various positions as well as some observations about details of pion capture stars. The energy deposited within various microscopic volume elements, as well as the LET distribution, is described. A discussion is also given of the results of weighing the dose with RBE-LET values given by Todd as well as the application of the cell survival model of Katz. (auth)

11682 (COO-1671-47) PARTICLE DETECTION AND CELLULAR INACTIVATION: A UNIFIED THEORY OF TRACK STRUCTURE. Katz, R. (Nebraska Univ., Lincoln (USA)). 1973. 27p. (CONF-730345-1). Dep. NTIS $3.50.

From regional conference on radiation protection; Jerusalem, Israel (6 Mar 1973).

The response of many detectors, dosimeters, and biological cells in culture to energetic heavy ions is described by a model of track structure in which the effect of radiation is attributed to the interaction of the "electron flux spectrum" with the sensitive elements of the detector. In small subvolumes of the detector, and on the average, the response of the detector to the energy deposited by "delta rays" is asserted to be the same as it is to irradiation with gamma rays in a uniformly irradiated second detector. Differences in the response of the detector to gamma-rays and to the delta rays from heavy ions is attributed to the spatial and temporal differences in the energy deposition. Thus the sensitive element of a scintillator excited by one delta ray from an ion cannot respond to a second delta ray from the same ion, though conceivably it could respond to Compton electrons from two gamma-ray photons in the time of irradiation of a block of material with gamma rays. The theory considers the gamma-ray dose-effect relation as a transfer function, to be applied to the spatial distribution of local dose about the path of a heavy ion, so as to convert the dose distribution to a distribution in effect. Such a procedure yields the spatial distribution of developed emulsion grains about the path of an ion in nuclear emulsion, to simulate the track of a heavy ion. Integration of the effect over all possible radial distances yields the pulse height, for a scintillation counter, or the inactivation cross-section when enzymes are bombarded, or the ion-kill cross section for the inactivation of a biological cell by a single heavy ion, as in the passage of a cosmic ray particle through biological matter. For biological matter, where it is possible to accumulate sublethal damage, there is a second possible inactivation mode, called the gamma-kill mode (because of its resemblance to the way in which secondary electrons from many gamma-ray photons inactivate cells) through which delta rays from several ions in a beam can collectively inactivate cells. The theory is one whose functional form is dictated by its internal logic, but whose parameters must be determined experimentally. Once these are known, the response of the detector to any specified radiation environment may be calculated. The model suggests that many accepted concepts of radiation science must be carefully reevaluated. (auth)

11683 (COO-3384-1) [NEUTRON AND PHOTON TRANSPORT]. Final Report. Aronson, R. (New York Univ., N. Y. (USA)). 4 Jun 1973. Contract AT(11-1)-3384. 24p. Dep. NTIS $3.25.

Various aspects of the transport of neutrons and photons, particularly in slab geometry, have been investigated. One investigation led to the observation that it is possible to write down formal solutions of transport problems in slabs by inspection in terms of the boundary conditions. It was shown previously that solutions of an assortment of problems could be written in terms of a few basic quantities, which occurred again and again. Prescriptions were given to evaluate these quantities. In the present work physical interpretations have been given to each of these quantities. Use of these interpretations obviates the need for any further algebra. A second line of effort extended the Transfer Matrix Method for transport problems to polarized light, e.g., sunlight incident on the atmosphere. The polarization produces a sort of asymmetry—what appears clockwise looking from one side appears counterclockwise from the other. The generalizations were necessary to apply the method to polarized radiation. A third effort resulted in the determination of the limitations on the Legendre coefficients in order that quadratically anisotropic scattering result in non-negative cross sections. Finally, the eigenvalues of the one-speed transport equation were investigated for two different situations. In one, the medium is multiplying and the scattering is forward-peaked; the eigenvalues can be complex. The other is a neutron wave problem. The behavior of the eigenvalues has been examined as a function of the values of the parameters and families of curves obtained. In these studies the dependence of the solutions obtained on the order of the approximation used was also determined. (auth)

11684 (KFK-1829) DIRECT MEASUREMENT OF BODY DOSE IN PERSONNEL DOSIMETRY. Piesch, E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Abt. Strahlenschutz und Sicherheit). Aug 1973. 35p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

According to the concept of personnel dosimetry applicable to this date the measurement of a surface absorbed dose at the front of the body at the place of the dosimeter is required. At present, the body dose is evaluated from the value measured by the dosimeter, taking into account additional information about the radiation field (energy, direction). Based on a phantom calibration and following the concept of a body dose measurement, the absorbed dose appearing in any depth of the tissue or in the interesting critical organs is directly indicated on the surface of the body by means of a personnel dosimeter. The relevant requirements of phantom calibration will be discussed. With the help of equipment factors determined experimentally and given dose conversion factors the reading of a personnel dosimeter can be directly related to the absorbed dose prevailing at any interesting point in the body or to any defined dose equivalent function. The dosimeter properties of both measuring methods are discussed with particular view to the energy and direction dependence of a body dose estimate. (auth)

11685 (NP-19873, pp 101-104) STUDY OF X-RAY TRANSITION RADIATION BY HIGH ENERGY ELECTRONS. Higashi, S. (Osaka City Univ.); Honda, K.; Miono, S.; Ozaki, S.; Takahashi, T. 1973.

11686 (ORNL-4903) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1973. (Oak Ridge National Lab., Tenn.). Sep 1973. Contract W-7405-eng-26. 211p. Dep. NTIS $7.60.

Twenty-four chapters are included, separate abstracts were prepared for 20 sections. Material not covered was in urban research and education and information. (MHR)

For abstracts of individual sections see: 10105, 10217–10219, 10390–10392, 10470–10472, 10477, 10863, 11174, 11175, 11687–11690, 12028, and 12354.

11687 (ORNL-4903, pp 31-44) ATOMIC PHYSICS. Hurst, G. S.; Garrett, W. R.; Payne, M. G.; Talmage, J. E.; Wagner, E. B. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

The following subjects are covered: the transport of resonance radiation, decay of resonance photons in argon gas, quenching of resonance excited states with molecules, and the mathematical formulation of radiation-stimulated biological effects. (MHR)

11688 (ORNL-4903, pp 58-71) THEORETICAL RADIATION PHYSICS. Ritchie, R. H.; Alton, G. D.; Anderson, V. E. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

The following subjects are covered: pion dosimetry; stopping power of matter for neutrons; calculation of the Z_1^3-dependent stopping power contribution and its influence on ranges, mean excitation potentials, and shell corrections; a program for obtaining a relationship between quality factor and LET; the linear response function of a random assembly of molecules; complex potential methods for molecular scattering; rotational resonances in molecular scattering of ultra-low-energy electrons; collisions of alkali metal atoms with atomic oxygen; classical binary inelastic cross sections for excitation and ionization of electrons in atomic systems; high-energy satellites in Auger electron spectra from solids; surface plasmons in cylindrical geometry; and primary radiation processes in the physical stage. (MHR)

11689 (ORNL-4903, pp 83-92) INTERACTION OF RADIATION WITH LIQUIDS AND SOLIDS. Arakawa, E. T.; Birkhoff, R. D.; Braundmeier, A. J. Jr. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Research on surface plasmon excitation and properties is summarized. (MHR)

11690 (ORNL-4903, pp 103-109) PHYSICS OF TISSUE DAMAGE. Arakawa, E. T.; Birkhoff, R. D.; Cochran, W. T. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

The following subjects are discussed: electron-slowing-down studies, optical properties of organic liquids, radiation interactions with nucleic acid bases, and optical and electronic properties of chlorophyll. (MHR)

11691 (ORNL-TM-4266) EFFECTS OF AIR-DENSITY PERTURBATIONS ON THE TRANSPORT OF GAMMA RAYS PRODUCED BY POINT GAMMA-RAY SOURCES. McGregor, B. J.; Mynatt, F. R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $5.25.

A series of MORSE Monte Carlo calculations were performed to determine the effect that changes in the air density produced by one weapon detonation would have on the transport of gamma-ray radiation produced by a second weapon detonated about one second later. The response of interest was the ionization that would be induced in silicon by gamma rays in the vicinity of and beyond the first burst. A gamma-ray emission spectrum was used for the second weapon and four burst separation distances were considered. The medium was assumed to be infinite air, and spherical geometry was employed with the origin at the center of the second detonation. The changes in density about the first detonation were handled with a pseudo-collision technique. Boundary-crossing estimators were used at two radii from the second detonation and within nine solid angles measured from an axis passing through both detonations. Total, uncollided, and time-dependent gamma-ray ionization responses were calculated at each detector position. Total responses calculated for a position in the perturbed air immediately beyond the first burst were about 50% higher than those obtained in unperturbed air; an even greater increase was calculated for the uncollided response, which is a significant portion of the total response at detector positions between 1000 and 1500 m from the source. The changes in the total ionization due to the perturbations were very similar to the changes in the neutron displacement calculated for a 14-MeV neutron source in a previous study. Changes in the peak ionization rate followed changes in the total ionization for large separation distances but were less for small separations. (auth)

11692 (ORNL-TM-4322) EXREM III COMPUTER CODE FOR ESTIMATING EXTERNAL RADIATION DOSES TO POPULATIONS FROM ENVIRONMENTAL RELEASES. Trubey, D. K.; Kaye, S. V. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 82p. Dep. NTIS $6.25.

EXREM III is a computer code to estimate the dose equivalent rate and the total dose equivalent from beta, positron, electron, and gamma radiation resulting from submersion in contaminated water, submersion in contaminated air, and exposure to a contaminated surface. There can be more than one environmental release, and exposure can begin at any time after the first release. EXREM III considers contributions from environmental releases and from nuclide decay chains. For a particular problem the user may choose to calculate either the dose rates, or the total doses, or both for any of the three modes of exposure. A separate solution array is printed for each mode of exposure. EXREM III is a revised version of EXREM II which was available earlier. The principal revisions include treatment of positron and electron radiations, selection of nuclear data from a data base, variable dimensioning of large data arrays, and free field input. (auth)

11693 (ORNL-TM-4335) RADIATION TRANSPORT CROSS-SECTION SENSITIVITY ANALYSIS: A GENERAL APPROACH ILLUSTRATED FOR A THERMONUCLEAR SOURCE IN AIR. Bartine, D. E.; Oblow, E. M.; Mynatt, F. R. (Oak Ridge National

Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 84p. Dep. NTIS $6.25.

A general approach to radiation transport cross-section sensitivity analysis is introduced and its applicability demonstrated for a problem involving neutron and gamma-ray transport in air. The basis for the method is generalized perturbation theory using flux solutions to the transport equation and its adjoint. Both an analytical aspect of the technique, designed for surveying the sensitivity of a result to the entire cross-section data field, and a predictive aspect, designed for predicting the effect of changes in the data field, are presented. The analytic procedure is demonstrated by results that include a determination of important energy regions in the total, partial, and gamma-ray-production cross sections of nitrogen and oxygen for deep-penetration calculations of tissue dose in air. The predictive capability is illustrated for specific cross-section perturbations in the system and the effects of truncating the Legendre expansion of the scattering kernel. In addition, the applicability of the method for predicting variances in a calculated result arising from cross-section data uncertainties is demonstrated. In the sample case, the variance in the total neutron–gamma tissue dose is estimated from preliminary cross-section error files given in the evaluations of the nitrogen and oxygen cross sections. (auth)

11694 (SSI-1972-26) SECONDARY RADIATION FROM A SPHERIC TISSUE EQUIVALENT PHANTOM IRRADIATED WITH ^{60}Co γ- RADIATION AND 6 MV X RADIATION. Nilsson, B. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Aug 1972. 75p. (In Swedish). Dep. NTIS (U. S. Sales Only) $5.75.

Measurements of the exposition rate of the scattered radiation at total irradiation of spherical tissue equivalent phantoms have been done. ^{60}Co-γ radiation and 6 MV x radiation were used. The exposition rate was found to be dependent on the mass of the phantom in a non linear way. The exposition rate varied with a factor of 4.0 with scattering angles between 30° and 130° for ^{60}Co-γ-radiation. For 6 MV x radiation the exposition rate varied with a factor of 11.0 for the same angles. The calculations of the exposition rate have been done with both approximative and Monte Carlo methods. For ^{60}Co calculated and experimental values agreed quite well. For 6 MV x radiation the experimental values were only 75% of the calculated. Further calculations showed that the exposition rate depended on the spectrum. For another spectrum the calculated exposition rate was only 10% higher than the experimental. (SW)

11695 (SSI-1972-28) BUILDUP STUDIES AT AIR CAVITIES WITH THIN THERMOLUMINESCENT DOSIMETERS. Nilsson, B. O.; Schnell, P. O. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Sep 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The build-up situation behind different air cavities in a polystyrene phantom has been measured. As dosimeters, LiF-Teflon discs with a thickness of approximately 10 μm were used. The results for ^{60}Co γ-radiation are about 20% lower than the values published by EPP et al. (1958). A higher relative surface dose has been found for 6 MV and 42 MV x-rays than for ^{60}Co γ-radiation for the cavities used in this investigation. Considering the values of the relative surface dose only, 6 MV and 42 MV x-rays are probably not worse in treatment of tumors in the upper respiratory system than ^{60}Co γ-radiation. (auth)

11696 (SSI-1973-18) MICRODOSIMETRY IN HIGH ENERGY ELECTRON AND ^{60}Co γ RAY BEAMS FOR RADIATION THERAPY. Lindborg, L. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Sep 1973. 23p. (B). (CONF-730968-3). Dep. NTIS (U. S. Sales Only) $3.25.

From fourth international symposium on microdosimetry; Verbania, Italy (24 Sep 1973).

Microdosimetry measurements were performed at 42 MeV betatron used for radiation therapy. The measurements were made in a tissue equivalent phantom at two depths using 8 MeV and 38 MeV electrons respectively. Conventional pulse height measuring techniques were used. Some comments about the special problems involved in applying such techniques in betatron beams are given. A chemical analysis of the elemental composition of the tissue-equivalent Shonka-plastic A-150 were made. Preliminary results seem to indicate that at both electron energies the single-event spectrum changes towards larger energy depositions at a larger depth in the phantom. These changes are similar to those observed in a ^{60}Co γ ray beam. (auth)

11697 (SSI-1973-20) MICRODOSIMETRY IN ELECTRON BEAMS. Bengtsson, L. G.; Lindborg, L. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Sep 1973. 12p. (CONF-731012-4). Dep. NTIS (U. S. Sales Only) $3.00.

From thirteenth international congress of radiology; Madrid, Spain (15 Oct 1973).

The concept of microdosimetry and its possible application for use in high energy electron beams are presented. Some of the quantities used in microdosimetry are presented, and their possible use in radiobiology and radiation dosimetry is discussed. The experimental problems in microdosimetry measurements with electrons are discussed very briefly. Finally, some preliminary results are given, and their possible use in the evaluation of relative biological efficiency and dose fractionation studies is discussed. (auth)

11698 CONFERENCE ON MATHEMATICAL ASPECTS OF TRANSPORT THEORY. Zweifel, P. F. (Virginia Polytechnic Inst. and State Univ., Blacksburg). Transp. Theory Statist. Phys.; 3: No. 1, 65-77(1973).

An informal conference was held on this topic at the Virginia Polytechnic Institute and State University in January 1973. The invited participants were, for the most part, persons primarily interested in the application of mathematical methods in transport theory. They were urged to present work in progress and speculative ideas, with a view toward stimulating discussion. Brief reviews of the remarks of some of the speakers are given. Among the topics discussed are the following: the inverse problem, Case's method, singular perturbation methods, resolvent kernels, phase-space time evolution method, comparison of diffusion and transport theory, quarter space problems, analysis of light water reactors, nonlinear integral equations for neutron density in other than plane geometry, anisotropic scattering, and generalized spectral decomposition. (RWR)

11699 CALCULATION OF PAIR PRODUCTION CROSS SECTIONS OF GAMMA RAYS FOR RANDOM-WALK HANDLING OF TRANSPORT PROCESSES. Marenkov, O. S. At. Energ. (USSR); 35: No. 3, 209-210(Sep 1973). (In Russian).

The formula used for calculating the subject cross sections is given, and the results of the calculation for 48 elements are tabulated. (1 table) (MWG)

11700 CORRECTION OF DOSE DISTRIBUTION FOR OBLIQUE INCIDENCE IN THERAPY USING 6-MV X RAYS AND ^{60}Co GAMMA RAYS. Obata, Y. (Nagoya Univ., Japan); Okumura, Y. (Nagoya Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 7, 596-601(Jul 1973). (In Japanese).

The isodose curve shift method is one of the methods for correcting dose distribution for oblique incidence. Although it is simple to apply clinically, the procedure has been derived empirically, and further studies are necessary in order to establish this method. In this report the shift method was derived from inverse square law, and it was applied to the distribution of 6 MV x rays and ^{60}Co γ rays. There was a following relationship between the lack of tissue (h) and the distance shifted of isodose curve for the correction (Δd): $\Delta d = ah$, where "a" is the correction factor. "a" was estimated to be −0.33 for 6 MV x rays and −0.51 to 0.34 depending on source skin distance (SSD), from 50 to 100 cm, for ^{60}Co γ rays. The assumed errors by this method were 3% and 6% for 6 MV x rays and ^{60}Co γ rays respectively. (auth)

11701 PROCEDURES IN RADIATION THERAPY DOSIMETRY WITH 5 to 50 MeV ELECTRONS AND ROENTGEN AND GAMMA RAYS WITH MAXIMUM PHOTON ENERGIES BETWEEN 1 AND 50 MeV. Recommendations by the Nordic Association of Clinical Physics. Acta Radiol., Ther., Phys., Biol.; 11: No. 6, 603-624 (1972).

Recommendations for dosimetry procedures of ^{60}Co radiation therapy apparatus and accelerators in the Nordic countries are presented. These deal both with initial measurements of the apparatus and continuous controls of items important for the dosimetry. They include methods for energy determination, considerations regarding beam definition, and means of calculating the absorbed dose at any point in a phantom. (auth)

11702 SOLUTION OF THE STATIONARY RADIATION TRANSPORT PROBLEM FOR ENERGY SCATTERING USING MATRIX FUNCTIONS. Melcher, H.; Gerth, E. (Paedagogische Hochschule, Erfurt, Ger.). Kernenergie; 16: No. 2, 47-52(Feb 1973).

The transport equation of Boltzmann is formulated and solved by means of an infinite equation of matrices for the case of the stationary rectilinear propagation of radiation with respect to energy scattering only. It is shown that the matrix formalism is the proper one to explain the qualities of transformations and the non-commutativity of the radiation transmitted through compound, heterogeneous layers of material. Furthermore, an analytical and perspicuous representation of the transmission of divergent beams is given. Finally, simple equations for the flux of radiation, the mean range, and the counting rate are set up. (1 figure) (auth)

11703 ASPECTS IN PRACTICAL NEUTRON DOSIMETRY WITH IONIZATION CHAMBERS. Kuehn, H. (Gesellschaft fuer

Strahlen- und Unweltforschung mbH, Munich). Biophysik; 10: No. 3, 229-234(1973).

The calibration procedure to determine the absorbed dose within a phantom irradiated with fast neutrons is described for ionization chambers. A comparison between values of the neutron dose determined with paired ionization chambers and values of the neutron fluence measured with a fission chamber (^{238}U) is given. The comparison indicates the energy variation of the fast neutrons within a phantom irradiated with 14 MeV neutrons. (auth)

11704 DOSIMETRY FOR TOTAL-BODY ELECTRON-BEAM THERAPY IN THE TREATMENT OF MYCOSIS FUNGOIDES. Edelstein, G. R.; Clark, T.; Holt, J. G. (Memorial Hospital, New York). Radiology; 108: No. 3, 691-694(Sep 1973).

A 6-MeV linear accelerator was adapted for superficial total-body electron-beam therapy. The energy of the electron beam was reduced to 2.5 MeV by a 1 cm × 1m × 2m polystyrene screen placed 4.5 m from the accelerator. The patients were treated behind the screen, which acted as a scatterer and also contained three parallel-plate ionization chambers for dosimetry and beam monitoring. The bremsstrahlung dose was reduced to 0.7% of the electron dose by lining the collimators of the accelerator with aluminum. Instrumentation and techniques developed in determining the depth dose, dose distributions, and bremsstrahlung dose are discussed. (auth)

11705 ACHIEVEMENT OF UNIFORM DOSE WITHOUT OVERLAP IN MULTI-PORT TREATMENT FIELDS, INCLUDING INTERPORT SHAPED BLOCKS. Starchman, D. E.; Loeffler, R. K.; Sommer, R. D. Radiology; 108: No. 3, 695-698(Sep 1973).

A technique is described for treating large areas with multiple ports without gaps or overlaps by rotating the therapy unit about the source. The overall effect is the same as if one large field were used with a single comprehensive set of precise shielding blocks. Minimal set-up time permits routine use of this method. Modifications for use with conventional megavoltage x ray teletherapy units are discussed. (auth)

11706 AVERAGE ENERGY PER ION PAIR FOR ALPHA PARTICLES IN VAPORS OF SEVERAL DIELECTRIC LIQUIDS. Nakayama, T. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 6, 1431-1436(Jun 1973).

The W-values for alpha particles in several kinds of vapors were determined. A cylindrical ionization chamber of inside diameter 20 cm and length 55 cm was used for measurements. Alpha particles emitted from ^{210}Po source entered to the ionization chamber through a collimator with mylar window. The vapors were obtained from highly purified samples for spectroscopy. For the vapors, relative measurements with argon, nitrogen, and dried air as standard gases have been carried out. The W-values obtained within about 3% error for the vapors of n-hexane cyclohexane, benzene, carbon disulphide, dichloromethane, and carbon tetrachloride were 29.1 ± 0.5, 28.1 ± 0.6, 30.9 ± 0.7, 26.0 ± 0.5, 26.8 ± 0.5, and 28.7 ± 0.7 eV, respectively. These W-values were somewhat large on comparison with those for electrons. (auth)

11707 IMPLANTATIONS OF IONS. II. Study of Distribution of Effective Ranges of Phosphorus Atoms Implanted into Silicon Monocrystal. Golanski, A. (Instytut Badan Jadrowych, Swierk, Poland); Dybczynski, R. Nukleonika; 18: No. 8, 351-360(1973). (In Polish).

The neutron activation analysis was used to determine the concentration profile of phosphorus implanted to silicon in the energy range 16 to 60 keV. Comparison of the results with the predictions of the LSS theory is discussed. (auth)

11708 IMPLANTATIONS OF IONS. I. Elements of Theory of Ranges. Golanski, A. (Instytut Badan Jadrowych, Swierk, Poland). Nukleonika; 18: No. 8, 335-350(1973). (In Polish).

The elements of theory of ion ranges in amorphous solids are briefly reviewed. Equations for average projected range $\bar{R}_p$ and standard deviation of the projected range ΔR_p as well as numerical values of $\bar{R}_p$ and ΔR_p for B, N, Al, P, Ga, As, In, Sb ions implanted to silicon in the energy range 20 to 200 keV are given. (auth)

Radiation Protection Standards

Refer also to abstract 10504.

11709 (ICRU-19(Suppl.)) DOSE EQUIVALENT. (International Commission on Radiation Units and Measurements, Washington, D. C. (USA)). 1 Sep 1973. 7p. ICRU Publications, Washington, D. C. $1.00.

A formulation of the dose equivalent is presented, which treats the dimensions of the quantities in the dose equivalent equation. (MHR)

11710 (SSI-1973-23) ESTABLISHMENT OF STANDARDS AND WORKING LIMITS FOR RADIOACTIVE CONTAMINANTS. Lindell, B. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Nov 1973. 8p. (SM-180/77). Dep. NTIS (U. S. Sales Only) $3.00.

Basic standards recommended by the International Commission on Radiological Protection (ICRP) on dose limits are summarized. This includes doses to various human organs and tissues as well as population doses. The recommendation that all doses should be kept as low as is reasonable is discussed. (SW)

11711 PRODUCTION AND PROTECTION. Scheidauer, J. (Centre de La Hague, Cherbourg, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 2, 105-110(Apr 1973). (In French).

Radioprotection projects must involve the close collaboration of the party carrying out the work or construction and the specialized party supervising the work, the latter being concerned with the nuclear safety aspects of the problem. In the context considered, a project can range from a new industrial nuclear installation to work in a contaminated environment, an even elementary modification in working conditions being included in the definition. (FR)

11712 LAW OF 18TH JUNE 1938 ON THE USE OF X-RAYS AND RADIUM, ETC., WITH REGULATIONS AND RULINGS ON THE SAME. Oslo; Groendahl og Soen (1965). 8p. (In Norwegian).

The original law of 1938 defines the authority of the government to issue regulations governing the use of x rays, radium, and radioactive materials. Such regulations include the qualifications, working conditions, etc., and medical examination of personnel and the inspection and authorization of equipment and materials. The regulations regarding inspection of x-ray equipment, radium, etc., of October 22, 1948, are given. Regulations regarding working conditions for personnel of November 21, 1947, are also given. Finally, guidelines issued by the Factory Inspection Directorate for precautions for personnel are given. (NO)

Radiation Source Calibration and Standardization

Refer also to abstract 10389.

11713 (LA-5455-MS) USE OF MULTIPLE 4π RADIATION SOURCES FOR QUASI-UNIFORM IRRADIATION OF SQUARE SURFACES. Clark, R. W.; Freiwald, D. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

The question of distance and location of multiple 4π radiation sources from square planar target surfaces is addressed, with the constraint that the surface be irradiated with 80% uniformity. Results of computer calculations are presented, giving source location coordinates for optimum use of the sources under the uniformity constraint. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 10766, 10813, and 11358.

11714 (GKSS-73-E-17) LGH-G: A PROGRAM TO CALCULATE γ-RADIATION THROUGH PARTLY SHIELDED OPENINGS. Fiebig, R.; Rybaczok, P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1973. 54p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

The LGH-G program deals with the task of calculating the shielding effect of an infinitely extended plane radiation source through two plane shielding layers lying on top of one another, with the absorption coefficients u_1 and u_2 for the γ-radiation of the source, i.e., the γ-radiation distribution for the single energies are single points behind the layers. The first or second layer as far as the radiation source is concerned can be bored through. Thus the program permits the following variations: a) two continuous shielding layers, b) two shielding layers, one continuous, the other bored through, c) a shielding, consisting of only one material, d) a shielding of one material with a borehole to any desired depth, or completely bored through. The build-up factor methods have been used in TAYLOR approximation. (GE)

PHYSICS (THEORETICAL)

General

Refer also to abstracts 11300 and 12461.

11715 (JINR-E2-7485) SEQUENCES OF PARASTATISTICS. Govorkov, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

In the theory of Green paraquantization the condition of uniqueness of the vector which plays the role of the vacuum vector in the theory of ordinary quantization is renounced. All irreducible separable representations of the paracommutation Green relations are considered. The properties of the ground state vectors of these representations, which are called "reservoir vectors", are established. Using some examples the way in which the general Green relations and the specific boundary conditions for the reservoir vectors yield the parastatistics of a given order is illustrated. The sequences of parastatistics are formed. (auth)

11716 NON-TRIVIAL SOLUTIONS OF THE HARTREE–FOCK EQUATIONS FOR A VERY-MANY-PARTICLE SYSTEM. de Llano, M. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 75-95(1973).

Work related to proofs for the existence of energetically preferred, non-trivial (mostly periodic-density) solutions to the Hartree–Fock equations is reviewed. Both long- and short-ranged interacting systems of N-bosons or -fermions ($N \gg 1$) are considered, and stability criteria discussed. Also, some exact results associated with trivial (plane-wave) solutions are surveyed. The main conclusion is that, for any fixed physical density, a sufficiently strong interparticle coupling can induce the appearance of non-trivial HF states. These solutions provide a first step in studying the properties of many-particle systems, which range from astrophysical plasmas and quantum crystals to nuclear matter and helium at very low temperature. (auth)

11717 POINT TRANSFORMATIONS IN QUANTUM MECHANICS. Wolf, K. B. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 45-74(1973).

First a review is presented of the definition and properties of classical and quantum canonical transformations, from the point of view of a current program on the role of canonical transformations in quantum mechanics. The groups and the corresponding infinitesimal algebras are explored. The subgroup of point transformations (i.e. canonical transformations between pairs of conjugate observables, where one of a pair is function only of one of the other pair) is of special interest since it is a group of transformations for which classical and quantum mechanics follow each other. Only the group of inhomogeneous symplectic transformations has similar characteristics. Point transformations are treated in detail and a principal series of unitary representations is constructed. (auth)

11718 AZIMUTHAL QUANTIZATION OF ANGULAR MOMENTUM. Levy-Leblond, J. M. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 15-23(1973).

Angular momentum in quantum mechanics is usually studied by diagonalizing its zenithal projection J_O. An alternate scheme is developed here by defining an operator γ corresponding to the orientation of the azimuthal plane around the polar axis. In the $(2j + 1)$-dimensional eigenspaces of J^2, the eigenvalues of the azimuthal direction are regularly distributed with a spacing $2\pi/(2j + 1)$. The corresponding eigenstates of γ, when expanded upon those of J_O, show a great analogy with the coherent states of the quantum harmonic oscillator. (auth)

11719 BRASHINSKET AND ITS COMPUTATION. Brody, T. A. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 22: No. 1-2, 199-214(1973).

The principal computational schemes for obtaining the harmonic oscillator transformation bracket (or brashinsket) are briefly described and compared as regards speed. The technique of building a table of already calculated values for reuse is then discussed; when used with a recursive computational scheme, this technique is better by a factor of 10 or more in an extensive calculation. (auth)

11720 RELATIVISTIC TEMPERATURE SHIFT OF THE ENERGY OF MOESSBAUER RADIATION AND DOPPLER FORMULA. Lebedev, V. A.; Bakov, E. K. Vestn. Mosk. Univ., Ser. II Khim.; 14: No. 2, 237-238(1973). (In Russian).

It is shown that the derivation of the relativistic temperature shift of Mössbauer energy can not be based on averaging the Doppler shift. (auth)

11721 ANALYTIC FORMULATION OF SU(3) VECTOR COUPLING COEFFICIENTS FOR n PARTICLES. Casilo, J. M.; Noz, M. E. (Indiana Univ. of Pennsylvania, Indiana). Comput. Phys. Commun.; 5: No. 5, 365-378(May 1973).

This program calculates analytically SU(3) vector coupling coefficients for a product of n particles. The calculation is done by evaluating the matrix elements of the SU(3) projection operator, using polynomial techniques. Also, SU(3) isoscalar factors for n particles are obtainable by using only part of the program. (LBS)

11722 NEARLY EXACT CALCULATION OF THE SOLUTION OF THE RADIAL SCHROEDINGER EQUATION. Marquez, L. (CEN de Bordeaux, Gradignan, France). Comput. Phys. Commun.; 5: No. 5, 379-389(May 1973).

This program is concerned with the calculation of the radial Schroedinger equation with an accuracy comparable to the capability of the computer. The program has been used to compute the wave functions given by the Yukawa or screened Coulomb potential, the Coulomb potential, and the spherical Bessel functions. (LBS)

11723 TIME ASYMMETRY AND QUANTUM EQUATIONS OF MOTION. Phipps, T. E. Jr. (Naval Ordnance Lab., White Oak, MD). Found. Phys.; 3: No. 4, 435-455(Dec 1973).

Accepted quantum description is stochastic, yet history is nonstochastic, i.e., not representable by a probability distribution. Therefore ordinary quantum mechanics is unsuited to describe history. This is a limitation of the accepted quantum theory, rather than a failing of mechanics in general. To remove the limitation, it would be desirable to find a form of quantum mechanics that describes the future stochastically and the past nonstochastically. For this purpose it proves sufficient to introduce into quantum mechanics, by means of a perfected formal correspondence, certain analogs of the classical initial-condition constants. Through the restoration of such parameters at the quantum level one accomplishes a natural accommodation of time anisotropy, wave function reduction, and "event" description by quantum mechanical equations of motion alone, without the need for extra postulates (e.g., a projection postulate). This requires a complete restructuring of quantum measurement theory. (auth)

11724 INFORMATION AND GAUSSIAN WAVE PACKET. Chakraborty, C. G. (F. C. College, Diamond Harbor, West Bengal, India). Indian J. Pure Appl. Math.; 3: No. 5, 855-857 (Sep 1972).

The derivation of the Gaussian wave packet and its time-evolution were studied by information theory. (auth)

Quantum Field Theories

Refer also to abstracts 11250, 11733, and 11736.

11725 (COO-1764-181) DERIVATION OF GENERAL CONSERVATION LAWS AND WARD–TAKAHASHI IDENTITIES IN THE FUNCTIONAL INTEGRATION METHOD. Suura, H.; Young, B. L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy; Ames Lab., Iowa (USA)). 1972. 55p. Dep. NTIS $4.75.

A functional integration method is applied to derive Ward-Takahashi identities involving the energy-momentum tensor, currents, and fields. In the process of the derivation, a variational method was introduced to derive conservation laws, in which the improved energy-momentum tensor of Callen-Coleman-Jackiw is obtained. Establishing the correspondence between the c-number relations obtained in the functional integration method and the q-number ones resulting from the conventional way, it is demonstrated that the two approaches of the quantum field theory give identical results for the perturbation expansion, canonical equal-time commutation relations, etc. They are, therefore, equivalent. (auth)

11726 (COO-2271-21) APPLICATION OF CONFORMAL SYMMETRY TO QUANTUM ELECTRODYNAMICS. Christ, N. (Columbia Univ., New York (USA)). 1973. 35p. Dep. NTIS $3.75.

Conformal symmetry is used to determine the position space vertex function $\Gamma_\lambda(x,y;z)$ of massless quantum electrodynamics in terms of the current-current correlation function $\pi_{\mu\nu}(x, y)$ and coefficients E_1 and E_2 appearing in the Wilson expansion of the product $\bar{\psi}(y)\,\psi(x)$ of Fermi fields. This relation holds order by order in perturbation theory for graphs containing a single electron line, evaluated in a special position dependent gauge. The relation provides an explicit and perhaps simplified method

for computing the vacuum polarization amplitude $F_1(\alpha)$ and is used to analyze the behavior of single electron loop amplitudes in quantum electrodynamics for values of the coupling constant α near a zero of $F_1(\alpha)$. (auth)

11727 (JINR-E2-7540) SUPERPROPAGATOR REGULARIZATION OF THE S-MATRIX FOR CHIRAL LAGRANGIAN. Pervushin, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

The Lagrangian is calculated which allows one to reproduce the Honerkamp covariant perturbation theory by using the conventional perturbation theory. The superpropagator method of calculating the one-loop diagrams is shown to lead simultaneously to the normal ordering of the Lagrangian obtained. The covariant form is found for the S-matrix as the T-product with normal-ordered Lagrangian. (auth)

11728 (JINR-E2-7562) ULTRAVIOLET ASYMPTOTICS IN THE PRESENCE OF NONABELIAN GAUGE FIELDS. Belokurov, V. V.; Kazakov, D. I.; Shirkov, D. V.; Slavnov, A. A.; Vladimirov, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

The theory of Yang-Mills fields interacting with scalars and spinors and, in particular, spontaneously broken models are considered. All reasonably "simple" models of such a type, except for massless Yang-Mills field interacting solely with fermions, are shown to go outside the framework of weak coupling, at least for one of the coupling constants. However a possibility exists when the effective constant of quartic self-interaction tends to the finite value in the ultraviolet limit, whereas the Yang-Mills one tends to zero. The presence of a possible Yukawa type interaction does not change the situation qualitatively. (auth)

11729 (JINR-P2-7310) MODELS OF NONLOCAL QUANTUM FIELD THEORY AND PARTICLES AND THEIR VALIDATION. Vatagin, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The analysis of some models of nonlocal quantum field theory and particles is given. (auth)

11730 (NP-19808) EXTENSION OF THE SPECIAL THEORY OF RELATIVITY AND A SUPERLUMINAL MODEL FOR ELEMENTARY PARTICLES. Research Report No. 11, 1973. Piirainen, R. (Tampere Univ. of Tech. (Finland)). Jan 1973. 27p. Dep. NTIS (U.S. Sales Only) $3.50.

The Möbius and Lorentz transformations together are known to form in four-dimensional space the most general transformation preserving the nature of a uniform linear motion with light velocity. It is shown by purely mathematical reasoning that a superluminal motion combining with the Möbius transformation can maintain its nature almost uniquely but a subluminal one only conditionally, and that if the two transformations are real neither linear nor nonlinear motion can pass through the limiting velocity. A superluminal model is considered for elementary particles based on the Möbius transformation. The new model provides a solution to a number of problems associated with tachyon theories: in macrophenomena the causality and the upper bound for signal velocity remain valid, but it appears that the abandonment of microcausality cannot be avoided. The reasons for the stability of elementary particles are considered from both geometrical and kinetic viewpoints, and it is also suggested that certain equivalences may exist with the uncertainty relations of quantum mechanics. (auth)

11731 RELATIVISTIC QUANTUM FIELD THEORY IN CONFIGURATION SPACE. Kalnay, A. J. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Int. J. Theor. Phys.; 8: No. 3, 227-229(1973).

A relativistic quantum field theory in configuration space is considered and the consequences discussed. (UK)

Gravitation and General Relativity

Refer also to abstract 10872.

11732 INTRODUCTION OF MASSIVE SYSTEMS IN TWISTOR THEORY. Oliveira, C. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 3, 37-60(1973).

An alternative way for introducing massive systems in twistor theory is proposed. The process used is a perturbative approach starting from the usual twistor formalism for null rest mass systems. (auth)

11733 APPROXIMATE SOLUTION FOR THE CYLINDRICALLY SYMMETRIC MAGNETIC FIELD WITH SOURCE. Teixeira, A. F. daF.; Som, M. M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 2, 23-33(1973).

An approximate solution of the field equations of Einstein–Maxwell's theory is obtained for cylindrically symmetric metric due to oppositely charged clusters of particles moving in circles in counter directions. (auth)

11734 CARNOT CYCLES IN GENERAL RELATIVITY. Ebert, R.; Goebel, R. (Univ., Wuerzburg, Ger.). Gen. Relativity Gravitation; 4: No. 5, 375-386(1973).

From international conference on gravitation and relativity; Copenhagen, Denmark (Jul 1971).

Classical thermodynamics were developed with the assumption that, either no gravitational fields are present in the thermodynamic systems, or that the fields act on the Newtonian mass of the systems only and not on any other kind of internal energy like heat. In order to find the exact thermodynamic relations for systems with gravitational fields, the well known Carnot cycles are used, taking into account the action of gravitation. The gravitation is described by general relativity. The Carnot efficiency is calculated in the case of stationary fields. Temperature for general relativistic systems can be defined with the help of Kelvin's principle analogously to classical thermodynamics, and the Carnot efficiency can then be expressed with temperatures instead of heat energies. In the case of strong gravitational fields, the Carnot efficiency can become equal to one even if the temperatures are both different from zero. Thermodynamic equilibrium can be expressed by using the Carnot efficiency, and it can be proved that for equilibrium the Tolman relation $T\sqrt{g_{00}}$ = constant (relativity, thermodynamics and cosmology (1934)) holds quite generally for systems with stationary gravitational fields. (auth)

11735 QUANTUM ASPECTS OF THE EQUIVALENCE PRINCIPLE. Aharonov, Y. (Univ. of South Carolina, Columbia); Carmi, G. Found, Phys.; 3: No. 4, 493-498(Dec 1973).

Two thought experiments are discussed which suggest, first, a geometric interpretation of the concept of a (say, vector) potential (i.e., as a kinematic quantity associated with a transformation between moving frames of reference suitably related to the problem) and, second, that, in a quantum treatment one should extend the notion of the equivalence principle to include not only the equivalence of inertial forces with suitable "real" forces, but also the equivalence of potentials of such inertial forces and the potentials of suitable real forces. The two types of cancellation are physically independent of each other, because of the Aharonov–Bohm effect. Finally, it is shown that the latter effect itself can be understood "geometrically" as a kinematic effect arising upon the transformation between the two reference frames. (auth)

11736 CYLINDRICAL SYMMETRIC MAGNETOSTATIC FIELD IN EINSTEIN'S UNIFIED FIELD THEORY. Tiwari, R.; Kashyap, J. N. S. (Banaras Hindu Univ., India). Indian J. Pure Appl. Math.; 3: No. 5, 896-903(Sep 1972).

A magnetostatic field exhibiting cylindrical symmetry is considered, and a particular solution of the field equations in Einstein's unified field theory is obtained. The motion of a test particle is also discussed. (auth)

11737 CYLINDRICALLY SYMMETRIC ELECTROMAGNETIC FIELD OF THE SECOND CLASS. Roy, S. R.; Tripathi, V. N. (Banaras Hindu Univ., India). Indian J. Pure Appl. Math.; 3: No. 5, 926-937(Sep 1972).

Some solutions of the electromagnetic field equations for cylindrically symmetric space-time were obtained which correspond to the electromagnetic field tensor of the second class. (auth)

11738 GRAVITATIONAL INVARIANT $S = R^{hijk} R_{hijk}$. Tikekar, R. S. (Univ. of Poona, India). Indian J. Pure Appl. Math.; 3: No. 5, 783-790(Sep 1972).

The role played by the invariant $S = R^{hijk} R_{hijk}$ in different gravitational situations was examined, following earlier work in this connection. Several new results were obtained with reference to well known metrices. (auth)

REACTOR TECHNOLOGY AND REGULATION

11739 (INIS-mf-817) INVOLVEMENT OF DESIGN IN ERECTION OF REACTOR COMPONENTS. Mahindru, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A small design cell, representing the main designers, is located at construction sites of nuclear stations being built in India. The need and advantages of such a group in relation to erection of reactor components and auxiliaries are discussed. (auth)

11740 (INIS-mf-851) WATER CHEMISTRY IN NUCLEAR POWER REACTORS. Shankar, J. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 23p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The water chemistry of power reactors (water cooled and moderated), in particular corrosion and deposition phenomena, are discussed. Corrosion problems can be minimized by improvements in material selection and rigorous control of operational water chemistry, particular stress being laid on very low dissolved oxygen and chloride levels. In reactors where the manrem problem has arisen, there is no alternative to decontamination. Possible decontamination procedures are discussed. (auth)

11741 TECHNICAL REPORTS OF THE REACTOR CONFERENCE IN KARLSRUHE, 10–13 April 1973. Atomkernenergie; 21: No. 4, 298-302(1973). (In German).

From reactor meeting 1973; Karlsruhe, Ger. (10 Apr 1973).

An attempt is made to make the reader aware of a few important results of the reactor conference at Karlsruhe. The presentation is not confined to the distribution of sections but is restricted to a few specialist subjects. (GE)

11742 POWER REACTORS: A 1973 SURVEY. Villani, S. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 10, 527-533 (Oct 1973). (In Italian).

The outstanding facts occurred during the current year in the field of power reactors are reviewed. The development, both technical and commercial, is taken into consideration for different types of reactor systems. (auth)

11743 REACTOR MEETING 1973 OF THE GERMAN ATOMFORUM. Schmidt, G. Brennst.-Waerme-Kraft; 25: No. 7, 282 (1973). (In German).

From reactor meeting; Karlsruhe, Germany (10 Apr 1973).

The reactor meeting is briefly reported on with emphasis on the most important lectures. (GE)

11744 COMBINED FOSSIL AND NUCLEAR FUEL FOR THERMAL PLANT. Schoch, W. (to Grosskraftwerk Mannheim AG). German Patent 1,904,638. 20 Aug 1970. Filed date 31 Jan 1969. (In German).

A thermal plant is described where the saturated steam coming from the reactor is superheated by fossil fuel materials characterized by the fact that the heating installation for the superheater is connected with a heating installation of a conventional steam energy plant. (TSS)

11745 INZHENERNYE VEROYATNOSTNYE RASCHETY PRI PROEKTIROVANII YADERNYKH REAKTOROV. (Engineering Probability Calculations in the Design of Nuclear Reactors). Klemin, A. I. Moscow; Atomizdat (1973). 304p.

The first section reviews elements of probability theory and mathematical statistics useful in reactor calculations. Mathematical expectation and various types of error distribution (Gaussian, gamma, Pearson, Rayleigh, Fisher, hypergeometric, binomial, etc.) are covered. The second section deals with overall error estimation by linearization and by the application of Monte Carlo methods. Practical applications to reactor design are stressed. For example the error in estimating heat transfer burnout is estimated. The effect of errors in estimating the amount of uranium in the fuel, enrichment, amount of adsorber, etc. on the reactivity of the reactor is discussed. Reactor reliability and shutdowns are discussed in probability terms. The reliability of individual elements of a reactor are estimated for the central zone, the reactor vessel, control system, high-pressure lines, pumps, generators, and other elements of the primary circuit. Reactor reliability is estimated for parallel and mixed union of the various reactor elements. The probability of fuel element failures in the central core is calculated. The effect of creep and fatigue strength of reactor materials on reactor operation reliability is discussed. Reliability of pipes and valves in service is taken into account. The overall reactor reliability is estimated. The effect of component failures on radiation safety is discussed. The distribution of radioactive materials near a nuclear power plant is calculated in case of an accident. The radiation dose to the population from ^{131}I is calculated. The size of the exclusion zone is estimated. The last section deals with mathematical methods of planning experiments. (SJR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 10742, 10750, 11779, 11992, 12029, 12044, 12071, 12196, 12220–12225, 12228–12234, 12243–12245, 12248–12258, 12261–12265, 12267–12269, 12271, 12272, 12282, 12292–12310, and 12312–12326.

11746 (CONF-720482-, pp 74-113) EVALUATION OF TORSIONAL EFFECTS ON SYMMETRIC AND UNSYMMETRIC STRUCTURES. Stoykovich, M. (Gibbs and Hill, New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Safety requirements dictate that nuclear power plants should be designed conservatively to withstand seismic disturbances. Torsional effects in the seismic analysis and design of structures of nuclear power plants are frequently overlooked. The significance of torsional effects on structures and other components of nuclear power plants of both pressurized water reactor (PWR) and boiling water reactor (BWR) types is described. (14 references) (auth)

11747 (CONF-720482-, pp 496-507) REVIEW OF SEISMIC DESIGN OF NUCLEAR STEAM SUPPLY COMPONENTS. Love, J. E. (General Electric Co., San Jose, CA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A review of seismic design considerations as applied to the components of a nuclear steam supply system is presented. This includes a brief summary of earlier attempts to provide interface data. Current trends in levels of seismic effects as applied to equipment design are indicated. (auth)

11748 (CONF-720482-, pp 765-771) SUMMARY OF CRITERIA AND PROCEDURES FOR IMPLEMENTING CRITERIA APPLICABLE TO PIPE RUPTURE. Evans, P. A. (Tennessee Valley Authority, Knoxville). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A summary of basic design criteria regarding pipe break is presented. Procedures for implementing the pipe break criteria are outlined and include a brief discussion of support arrangement and consideration of jet impingement loads. (auth)

11749 (CONF-720482-, pp 772-775) DEVELOPMENT OF A RATIONAL BASIS FOR SELECTION OF BREAK LOCATIONS. Hooker, N. A. (Babcock and Wilcox Co., Lynchburgh, VA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A brief discussion of the historical development of pipe break location criteria is presented. The difficulty in designing to a non mechanistic criteria is briefly discussed. Current industry efforts to develop more rational pipe break design criteria are also reviewed. (auth)

11750 (CONF-720482-, pp 776-785) REVIEW OF PIPE RESTRAINT DESIGN CONSIDERATIONS. Love, J. E. (General Electric Co., San Jose, CA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A review of pipe restraint design considerations as they have been applied in General Electric BWR plants is described. Current thinking is touched on with the direction in which General Electric is moving in pipe restraint design and analysis covered briefly. (auth)

11751 (CONF-730942-(P2), pp vp 1p.) STEAMHAMMER PROBLEM: DYNAMIC SHOCK LOADING OF CRITICAL REAC-

TOR PIPING SYSTEMS. McGeorge, R.; Swec, F. Jr. (EDS Nuclear Inc., San Francisco). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

11752 (MRR-76) DYNAMIC AND STABILITY BEHAVIOR OF BWRs WITH RESPECT TO PERTURBATIONS IN REACTIVITY, PRIMARY STEAM FLOW, WATER INLET VELOCITY OR SUBCOOLING. P. 2. Computer Code ADYSMO. Hoeld, A. (Technische Univ. Munich (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). Mar 1970. 89p. INIS.

A one-channel, one-dimensional, linear model is presented which describes (within the frequency domain) in an analytical way the dynamic and stability behavior of a boiling water loop or reactor (both under forced or natural circulation, pressure-controlled or pressure-varying conditions) with respect to perturbations in reactivity (or heating power), primary steam flow (or system pressure), water inlet velocity or subcooling. A description of the computer code ADYSMO for the model is given. (INIS)

11753 (MRR-77) DYNAMIC AND STABILITY BEHAVIOR OF BWRs WITH RESPECT TO PERTURBATIONS IN REACTIVITY, PRIMARY STEAM FLOW, WATER INLET VELOCITY OR SUBCOOLING. P. 3. ADYSMO Calculations Compared Against Experimental Results From Frequency Response Measurements at Boiling Water Loops and Reactors. (Technische Univ. Munich (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). Apr 1970. 42p. INIS.

A one-channel, one-dimensional, linear model is presented which describes (within the frequency domain) in an analytical way the dynamic and stability behavior of a boiling water loop or reactor (both under forced or natural circulation, pressure-controlled or pressure-varying conditions) with respect to perturbations in reactivity (or heating power), primary steam flow (or system pressure), water inlet velocity, or subcooling. The validity and efficiency of the model are demonstrated by comparing transfer functions being measured at different boiling water loops and reactors under different experimental condition types with the ADYSMO calculations. (INIS)

11754 (MRR-91) STATE REPORT ON PROBLEMS OF THE PRESENTLY KNOWN CONTAINMENT CONCEPTS. Engel, M.; Kirst, O.; Rauschmair, R.; Wild, E. (Technische Univ. Munich, Garching (F. R. Germany). Lab. fuer Reaktorregelung und Anlagensicherung). Sep 1971. 91p. (In German). INIS.

Containments of water-cooled power reactors are analyzed by showing the present knowledge and the resulting open problems. Starting with the actual types of containments (full pressure containment and pressure-suppression system) and the accompanying auxiliary systems, problems with strains are treated which result from actions from outside and the consequences from loss-of-coolant accidents, whose mathematical treatment is especially discussed. The mechanical and material problems resulting from these strains are analyzed. Questions are treated which are connected with tests and inspections during the construction and working period. (auth)

11755 (NEDO-10183) CORE STANDBY COOLING SYSTEMS FOR THE GENERAL ELECTRIC 1969 BWR STANDARD PLANTS. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). May 1970. 300p. Dep. NTIS $17.00.

To serve as an effective basis for review of the 1969 BWR Product Line Core Standby Cooling Systems, descriptive and analytical support information is presented for the CSC systems needed for four particular plant sizes: the small 183" vessel size (500 MW(e)), the intermediate 218" vessel size (800 MW(e)), the large 251" vessel size (1100 MW(e)), and a future potential 269" vessel size (1290 MW(e)). Although a complete project review of the future potential-sized plant has not been made, it is expected that a genetic review can be made of the CSC systems for the entire spectrum of plant sizes and future potential sizes. The employment of a more refined heat transfer analytical model, which has been used in all safety evaluations for the last two years, is the major reason for the excellent behavior of this new CSCS. For this reason, considerable emphasis is given to the detailed description of this model. Although not really related to the CSCS concept, analyses, or performance evaluations, the new systems will be built to conform to the applicable current codes and standards. (12 references) (auth)

11756 TRAINING OF POWER STATION PERSONNEL FOR THE NUCLEAR POWER STATIONS AT STADE AND BRUNSBUETTEL. Boeger, H. (Hamburgische Electricitaets-Werke AG, Hamburg); Chudzienski, E.; Goetz, A.; Mika, H. VGB Kraftwerkstechnik; 53: No. 9, 577-579(1973). (In German).

The nuclear power stations at Stade and Brunsbuettel were ordered in early 1968 and in 1970 respectively. The plant suppliers were required to train the operating personnel specifically for each plant. Training commenced two years before initial operation. The object was to employ these personnel during commissioning in order to ensure smooth initial operation. (GE)

11757 CORROSION INHIBITION IN NUCLEAR REACTOR FEEDWATER EQUIPMENT. Pearl, W. L. (to General Electric Co.). Canadian Patent 906,690. 1 Aug 1972.

It is found, surprisingly, that corrosion in a boiling-water reactor can be minimized by introducing between 50 and 30,000 parts per billion (i.e. $\times 10^{-9}$) of oxygen into the feedwater, together with a stoichiometric quantity of hydrogen. This can best be achieved by collecting the gases produced by radiolysis and metering them back into the system. The best results are achieved with carbon steels and low-alloy steels. (CA)

11758 EFFECTIVENESS OF FLOODING HEAT TRANSFER BY EMERGENCY CORE COOLING SYSTEMS FOR BOILING WATER REACTORS. Ogasawara, H. (Hitachi Ltd., Ibaraki, Japan); Kashiwai, S.; Naito, M.; Takashima, Y. Nippon Genshiryoku Gakkaishi; 15: No. 6, 421-427(Jun 1973). (In Japanese).

The effectiveness of emergency core cooling under loss-of-coolant accident conditions has been one of the most important safety issues that have interested the regulatory authorities in their review of applications for the construction of light-water-cooled nuclear power plants. Devices for flooding, to be adopted in conjunction with spray cooling, are included in emergency core cooling systems of Boiling Water Reactor (BWR) plants. The effectiveness of flooding heat transfer was tested with a full scale BWR fuel bundle simulator over the range of conditions expected in loss-of-coolant accidents. The results of the test prove the adequacy of the BWR flooding technique. (auth)

11759 PRESERVICE INSPECTION FOR INSERVICE INSPECTION OF NUCLEAR POWER PLANT. Ishikawa, K.; Ando, E.; Wakabayashi, T.; Sasahara, T. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo). Ishikawajima Harima Giho; 13: No. 3, 318-328(May 1973). (In Japanese).

In order to successfully carry out inservice inspection of a nuclear reactor coolant system in accordance with the ASME code section-XI, it is necessary to give sufficient consideration to the design and arrangement of the system components, with emphasis on plans for access, accumulation of experimental data on non-destructive inspection, and the development of automatic inspection equipment. These items are discussed and preservice inspection of the No. 2 unit of Fukushima Nuclear Power Station, Tokyo Electric Power Company, is illustrated. This preservice inspection, which was made using ultrasonic inspection equipment provided with remote control and automatic recording, is the first of its kind in Japan. Also introduced are some experimental data, manual and automatic ultrasonic inspection procedures, equipment used and inspection results. (auth)

11760 CLEANING CONDENSATE IN SEPARATE ION EXCHANGE FILTERS VK-50 TURBINE PLANT AT NUCLEAR POWER STATIONS. Nudel, A. M. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 5, 17-21(May 1972).

Translated from Teploenergetika; 19: No. 5, 13-15(1972).

In order to evaluate the effectiveness of ion exchange resins used in cleaning condensates at nuclear power stations by removing dissolved and suspended impurities, and also to check the design of individual units of the filters, an experimental plant with separate H-cation exchange and OH-anion exchange filters (diameter 2m) in series was installed and tested on the bypass circuit of a VK-50 plant. The investigation was conducted in two stages, the first coinciding with reactor startup after a long shutdown, the second, carried out under settled water conditions. Radioactivity levels of the following isotopes, reported during investigation of the filters, are tabulated: ^{24}Na, ^{18}F, ^{65}Zn, ^{59}Fe, ^{56}Mn, ^{131}I, ^{140}Ba, ^{60}Co, ^{99}Mo, and ^{64}Cu. It was found that the ion exchange filters, put into operation after establishing stable water conditions, ensure satisfactory removal of all impurities from the condensate over a lengthly period of time. (JGB)

11761 FACTORS AFFECTING THE SELECTION OF SITE AND THE BASIC DESIGN FOR THE TULLNERFELD NUCLEAR POWER STATION. Nentwich, A.; Nistler, W. (Gemeinschaftskernkraftwerk Tullnerfeld GmbH, Vienna). VGB Kraftwerkstechnik; 53: No. 10, 635-641(1973). (In German).

A nuclear power station with a BWR of about 600 to 700 MW proved particularly interesting in the context of a coordinated expansion program of the Austrian electricity supply industry. Site investigations based on economic and technical considerations led to the selection of an area in Zwentendorf near Vienna. The fiscal year 1976 to 1977 has been identified as the optimum installation period. (GE)

11762 NUCLEAR ENERGY CONVERSION. El-Wakil, M. M. Scranton, PA; Intext Educational Publishers (1971). 677p.

Information on nuclear energy conversion is presented under the following headings: survey of nuclear power systems; thermodynamic aspects of nuclear power; boiling reactor; pressurized-water reactor; gas-cooled reactor; fast breeder reactor; fluid-fueled reactors; organic-cooled and moderated reactors; thermionic energy conversion; thermoelectric energy conversion; direct energy conversion; fusion power; and nuclear power economics. (DCC)

11763 DIFFERENT LIDS FOR A PRESTRESSED CONCRETE PRESSURE VESSEL FOR LIGHT-WATER REACTORS. Bindseil, P.; Dietrich, R.; Eick, H. (Zentralinstitut fuer Forschung und Entwicklung, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 79-88(1973). (In German).

From second international conference on "structural mechanics in reactor technology"; Berlin, Germany (10 Sep 1973).

A description is given of two possible variants: a) end with steel space frame, b) end made of concrete. Fundamental requirements are ease of haulage and simple assembly of the components on the site. Strain patterns and stress distributions are given for the steel end and a stress analysis is made for the concrete end. The strength calculations show that both variants are realizable. (GE)

11764 DEVELOPMENT OF LIGHT-WATER REACTORS IN GERMANY. Keller, W. (Kraftwerk Union AG, Erlangen, Ger.); Kornbichler, H. Atomwirt., Atomtech.; 18: No. 10, 450-454 (1973). (In German).

The development of light-water reactors in the Federal Republic of Germany has been marked by a fast increase of unit size. A period of only 13 years lies between the VAK Kahl with 15 MW(e) and the commercial power station Biblis with 1,200 MW(e). There have been reactors with several intermediate power levels. This necessitated a large number of new developments for core internals, pressure vessels, primary coolant pumps, containments and other major components. Additional development has been undertaken in order to improve the operation of the nuclear power plants, to rationalize the production of components and to satisfy the increasing safety demands. After this fast development a period of consolidation seems to be necessary. The primary objectives for the near future are to further improve plant availability, to facilitate maintenance and inspection and to rationalize quality control, design and engineering work and licensing procedures. (GE)

11765 OPERATION EXPERIENCE OF TSURUGA NUCLEAR POWER STATION. Inoue, Y. (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo; 19: No. 1, 14-19(Jan 1973). (In Japanese).

Tsuruga nuclear power station is the first commercial power plant in Japan with a boiling water reactor. Construction of this plant began in May 1966, and operation began on March 14, 1970. On September 20, 1969, initial fuel was loaded, and since then, power-up test, 100 hour operation test and continuously loaded operation test were performed. Total generated electric power so far was 6000 gigawatt-hour, and rate of utilization was from 68.9 to 82.2 percent. First periodical inspection was performed from October 1 to November 13, 1970. Poison-curtain was taken out in 1971. Second inspection was performed from September to November in 1971, during which rare gas hold up instrumentation with activated carbon was equipped. Hold-up time of this instrumentation is 290 days for xenon, and 350 hours for krypton. Released gaseous radiation dose in 1972 was less than 1 millirem, and released liquid radiation in 1972 was 0.04 curie. (JA)

11766 OPERATOR TRAINING SIMULATOR FOR BWR NUCLEAR POWER PLANT. Itoh, M. (Tokyo Shibaura Electric Co. Ltd.). Toshiba Rebyu; 28: No. 9, 1006-1011(Sep 1973). (In Japanese).

A BWR nuclear power plant simulator has been built for the training of operators. It has become possible to operate a BWR plant through a duplicated actual plant control console from start-up to shutdown. Functions of the control console and of the radiation monitoring system can be subjected to real-time and precise-digital simulation up to 95 per cent by a TOSBAC-7000/20 digital computer, with no use of an analog computer. Normal, abnormal or emergency situations can optionally be initiated from the instructor's console. Operation of the simulator is closely similar to that of real plants. (auth)

11767 BOILING WATER REACTORS WITH PRESSURE VESSELS (BWR). Jad. Energ.; 19: No. 8, 273-281(Aug 1973). (In Czech).

Construction problems, power capacity, and other characteristics of boiling water reactors (G.E., AEG-Telefunken, ASEA, Hitachi, Toshiba) are reviewed. 14 references. (auth)

11768 NUCLEAR POWER PROGRAM EXPANDED IN FRANCE: CONCLUSIONS OF THE PEON REPORT. Com. Naz. Energ. Nucl., Notiz.; 19: No. 7, 32-34(Jul 1973). (In Italian).

With the order for two BWR's placed with GEC a start has been made in France on the long-advocated policy of building water-cooled nuclear plants of both of the PWR and BWR types. The second Peon Report, issued in May, also recommended a heavy increase in the Country's nuclear power capacity. Of this Report only the conclusions have been released, which are printed in full in this issue. (auth)

11769 STANDARD RECOMMENDED PRACTICE FOR SURVEILLANCE TESTS FOR NUCLEAR REACTOR VESSELS. 1973 Annual Book of ASTM Standards. Part 31. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-E-185-73).

A standard is presented which covers procedures for irradiating and testing mechanical test specimens for the purpose of monitoring and evaluating, at periodic intervals, the radiation-induced changes occurring in the mechanical properties of the reactor vessel steels of light water-cooled nuclear power reactors. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 10750, 11746, 11748, 11749, 11751, 11754, 11756, 11762–11764, 11769, 12010, 12013, 12029–12031, 12038, 12192, 12195, 12226, 12227, 12235–12242, 12246, 12247, 12259, 12260, 12266, 12270, 12273–12281, 12283–12291, and 12327–12348.

11770 (CONF-720482-, pp 252-266) STRUCTURAL DESIGN OF NUCLEAR POWER PLANT FACILITIES. Giordano, R. C. (Tennessee Valley Authority, Knoxville). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Experiences of designing for tornado loads are described. Various assumptions were studied and their effects evaluated. Windborne missiles and jet loads are also studied. (auth)

11771 (CONF-720482-, pp 448-459) MODELING TECHNIQUES AND PROCEDURES. Fortune, H. J. (Babcock and Wilcox Co., Lynchburgh, VA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A discussion of some of the various modeling techniques and procedures used by the Babcock and Wilcox Company in analyzing their primary reactor coolant system is presented. Some of the topics discussed are as follows: a method of increasing structural definition through partial system modeling; accounting for the seismic input into a system which is attached at several locations to a moving structure; accurately reflecting support configurations, orientations and locations; mass lumping and the selection of significant degrees-of-freedom; determining component flexibilities; and debugging input. (auth)

11772 (CONF-720482-, pp 809-831) RATIONAL APPROACH TO PIPE WHIP. Thailer, H. J. (Westinghouse Nuclear Energy Systems, Pittsburgh). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A rational approach to pipe whip is presented. The various levels of conservatism associated with respect to current criteria requirements are also discussed. Finally, the results of a series of pipe break tests both dynamic and static performed by Westinghouse are presented. (auth)

11773 (CONF-730942-(P2), pp vp Sect. E5/1) THEORY OF PUMP INDUCED PULSATING COOLANT PRESSURE IN PRESSURIZED WATER REACTORS. Penzes, L. E. (Combustion Engineering Inc., Windsor, CT). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The theory of pump induced pulsating pressure distributions in a PWR coolant annulus is developed. The calculated pressure distribution can then be applied to predict the dynamic responses of the reactor internals. The mathematical analysis is formulated in accordance with the linearized Navier-Stokes equations by assuming a compressible, inviscid liquid. These equations are combined to form a single equation in terms of the unknown pressure distribution. The boundary conditions are two concentric rigid walls in the radial direction and any combination of closed, open, and piston-spring supported end conditions in the axial direction. The pulsating pump pressure which induces the pressure fluctuation in the annulus is prescribed at a small opening of the outer cylindrical wall (pump inlet of the reactor). This formulation of

the problem determines a time dependent, mixed boundary value problem. For this case, the separation of variables technique cannot be applied and a solution of this problem would require a lengthy procedure utilizing numerical analysis techniques. Instead of using these methods, an approximate solution is obtained by introducing the concept of time dependent body force in the governing differential equations. With this conceptual substitution for the actual loading the time dependent, mixed boundary value problem can be represented as a forced vibration problem with homogeneous boundary conditions. This problem can then be solved by the method of normal modes. Numerical examples are provided which give the pressure distribution in the axial and circumferential directions of the annulus for various of one and/or several pumps. Using different radial thickness for the body force, a convergence study was also conducted with excellent numerical results. 12 references. (auth)

11774 (CONF-730942-(P2), pp vp Sect. E5/2) "SAFRAN" TEST LOOP MODEL EXPERIMENTATION AND ANALYSIS OF FLOW INDUCED VIBRATION OF PWR REACTOR INTERNALS. Berriaud, C. (CEN de Saclay, Gif-sur-Yvette, France); Livolant, M.; Assedo, R.; Cauquelin, C.; Dubourg, M. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Introduction to vibration phenomena. In a PWR the reactor coolant flow that goes through the reactor internals and the fuel assemblies is characterized by a high turbulence and this flow is able to induce some structural vibration. The SAFRAN Test loop consists of a reduced scale model of reactor vessel, reactor internals, dummies representing fuel assemblies and a system of three loops including pumps and damping tanks connected to the reactor vessel, the purpose of which is to simulate the flow distribution of 3 loops PWR. The scale of the model is ⅓. In general the construction technology used for the model is the same as one used for the reactor. All the structures in contact with the fluid are made of stainless steel. The instrumentation used on the SAFRAN test loop consists of: accelerometers, pressure sensors and relative displacement sensors. Approaches used for studying vibration phenomena and results are presented. (auth)

11775 (CONF-730942-(P2), pp vp 1p.) VIBRATION-MEASUREMENTS AND ANALYSIS IN NUCLEAR POWER PLANTS. Bastl, W. (Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

11776 (WCAP-7800(Rev.2)) NUCLEAR FUEL DIVISION QUALITY ASSURANCE PROGRAM PLAN. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1973. 41p.

Information on the Westinghouse Nuclear Fuel Division quality assurance program is presented under the following headings: organization and responsibilities; design control; procurement document control; instructions, procedures, and drawings; document control; control of purchased material, equipment, and services; identification and control of materials, parts, and components; control of special processes; inspection; test control; control of measuring and test equipment; handling, storage, and shipping; inspection, test, and operating status; nonconforming materials, parts or components; corrective action; quality control records; and audits. (JWR)

11777 (WCAP-7820(Suppl.2)) ELECTRIC HYDROGEN RECOMBINER FOR PWR CONTAINMENTS: EQUIPMENT QUALIFICATION REPORT. Wilson, J. F. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Oct 1973. 48p. Dep. NTIS $4.50.

Extensive tests have been performed on a production unit electric recombiner system to confirm that the production equipment will perform satisfactorily. These tests are in addition to and supplement the tests on the prototype recombiner which were reported in WCAP-7820, Supplement 1. A description of the production electric recombiner is given. This recombiner is essentially the same as the prototype except for some minor design changes developed during the course of the development of this program. The tests performed show that the production electric hydrogen recombiner is fully adequate for normal service and post-LOCA conditions. These tests and results obtained on the production recombiner and its associated equipment are summarized. (auth)

11778 (WCAP-8185(Amend.1)) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Core Report 17 × 17. Amendment 1. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1973. 451p.

The requirements for further technical information, the mechanical design, the nuclear design, and the thermal and hydraulic design for the Westinghouse PWR with 17 × 17 array fuel assemblies are presented. (DCC)

11779 INITIAL OPERATION EXPERIENCE WITH THE 650 MW NUCLEAR POWER STATIONS AT STADE AND WUERGASSEN. Keltsch, E. (Preussische Elektrizitaets-AG, Hanover). VGB Kraftwerkstechnik; 53: No. 9, 559-570(1973). (In German).

The nuclear power stations at Stade und Wuergassen are the first nuclear power stations in the Federal Republic to have been constructed without State finance. Following a four year construction period, the two stations came into operation at the turn of the year 1971-1972. Experience so far with these nuclear power stations is equally valuable to their constructors and operators. (GE)

11780 DIGITAL MODEL SIMULATION OF A NUCLEAR PRESSURIZER. Baron, R. C. (Honeywell Information Systems Inc., Phoenix, AZ). Nucl. Sci. Eng.; 52: No. 3, 283-291(Nov 1973).

A digital model for the application of analyzing the primary pressure transient of nuclear power plants is presented. No restrictive assumptions have been made, and a rigorous treatment of the conservation laws of energy and mass has been used. A comparison with experimental data from three different sources indicates good overall agreement. The model can be used as a design tool for pressurizer vessels and associated pressure control devices. (auth)

11781 DEVELOPMENT AND EXAMINATION OF DATA HANDLING SCHEMES FOR REACTIVITY MEASUREMENTS IN THE PRESENCE OF SPATIAL EFFECTS IN LARGE NUCLEAR POWER REACTORS. Ferguson, K. L. Pittsburgh; Carnegie-Mellon Univ. (1973). 255p. University Microfilms Order No. 73-21,074. Thesis (Ph.D.).

A detailed study via numerical experiments is made of the flux shape behavior during operational transients in nuclear power reactors. Observed deviations in shape from steady state for transients typical of differential rod worth measurements show the physical basis of the point kinetics approach to be, in general, inappropriate. The observed shape behavior is understood and explained by means of a basic conceptual discussion. The significance of the non-applicability of the point kinetics method is manifest in reactivity determination procedures based upon such an assumption. Simulation of single point detectors, half-core axial chambers and full-core chamber detector schemes in large PWR's and the inverse-kinetics based data handling approach show a significant dependence on detector location in the prediction of the reactivity involved in a given operational transient with detector prediction converging to the correct value, as determined by a space-time numerical treatment based on the space-time factorization approach, only after a delay time of the order of one minute for a one second rod motion in a zero power condition. The key parameter in the inverse kinetics-reactivity meter approach is shown to be the time behavior of the amplitude function. A general method is formulated for deriving the amplitude function from a set of point detector readings. The functional treatment of detector responses to reconstruct the amplitude function value is developed from a theoretically sound basis. Approximations are applied that are shown not to compromise the accuracy of the approach but aid in speed and ease of data handling. The study of an improved amplitude function prediction is motivated by the fact that an exact amplitude function input into the inverse kinetics scheme will yield exact, instantaneous reactivity determination. Results are presented for a detailed study of different axial PWR cores with core heights ranging from 10 feet to 14 feet. Operational transients in the form of small movement of control rods are treated. Studies of the control rod motion include both at-power and zero power conditions, absence and presence of part length rods and both insertion and withdrawal motion of the rods. For the sake of completeness and applicability of the developed data handling scheme, multi-region radial cases are also studied. (Diss. Abstr. Int., B.)

11782 INNER SHELL AND SUPPORTING STRUCTURE FOR USE IN A NUCLEAR REACTOR HAVING A REACTOR CORE AND A REACTOR TANK SPACED AROUND SAID CORE. Kaser, A. (to Vereinigte Osterreichische Eisen-und Stahlwerke Aktiegesellschaft). U. S. Patent 3,720,581. 13 Mar 1973. Priority date 30 Apr 1970, Austria. 6p.

A plurality of vertical inner shell plates form an inner shell and are free of direct interconnections. A plurality of vertically spaced, horizontal section ribs are provided, each of which surrounds the shell. A plurality of vertical posts are connected to the ribs to form therewith a cage adapted to be inserted as a whole into the tank around the core. Each of the inner shell plates is firmly secured to only one of the section ribs and vertically movably guided on all other section ribs. (16 claims, 6 drawing figures) (auth)

11783 OPERATION EXPERIENCE OF MIHAMA I, II NUCLEAR POWER STATION. Goto, N. (Kansai Electric Power Co. Inc.,

Osaka). Genshiryoku Kogyo; 19: No. 1, 19; 25-29(Jan 1973). (In Japanese).

Mihama I nuclear power station began commercial operation on November 28, 1970, and Mihama II began commercial operation on July 25, 1972. In the Mihama I and II nuclear power plants, pressurized water type reactors are installed, and generating capacity of the Mihama I and II is 340 megawatt and 500 megawatt, respectively. The total generated electric power of the Mihama I has reached 3400 gigawatt hour up to June 1972, and utilization rate has been 72 percents. Total generated power of the Mihama II has reached 450 gigawatt hour up to September 1972, and utilization rate has been 56 percent. Repair works performed on the Mihama I are as follows: reconstruction of primary seawater pipe, repair of primary gland packing, change of turbine bearings, erosion of steam pipes and accident of a main transformer. Periodical inspection of the Mihama I was performed from October 25 to December 29, 1971. Although present processing facilities of radioactive wastes have enough capacity with regard to the quantity of processing and decontamination rate, liquid waste evaporator, monitoring tank of liquid waste and so on are scheduled to be constructed. (JA)

11784 ANALYSIS OF STOCHASTIC FLUCTUATIONS IN A NATURAL CONVECTION NON-BOILING LIGHT-WATER REACTOR. Morishima, N. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 533-543(Sep 1973).

Numerical calculations have been made of both noise spectra and relative standard deviations for stochastic fluctuations in various state quantities of a system, such as for example, neutron number, coolant temperature and coolant flow-speed. The calculations are based on a theoretical model proposed by the author for a non-boiling liquid-cooled and -moderated reactor, and carried out for the case of natural convection cooling at various values of reactor power up to 100 kW. Some of the results are compared with experiment. It is shown that the low-frequency fluctuations, caused by coolant flow-speed fluctuations, become significant at increased power levels, and above several kW, the fluctuations in flow are visibly reflected in those of neutron number. (auth)

11785 SIEMENS PRESSURIZED WATER REACTORS. Jad. Energ.; 19: No. 8, 281-284(Aug 1973). (In Czech).

11786 IMPROVEMENTS TO PLATE HEAT EXCHANGERS AND THERMAL ENERGY PRODUCING INSTALLATIONS HAVING SUCH EXCHANGERS. (to Societe Creusot-Loire). French Patent 2,131,791. 23 Feb 1971. 20p. (In French).

A plate type heat exchanger is presented. It is composed of parallel plates forming spaces and compartments which communicate with one another alternately, some containing the heated fluid and the remainder containing the fluid to be heated. The exchanger is housed in a fluid circulation vessel. A special feature is that spacer elements positioned between the end plates and the vessel are constructed to communicate to the vessel any force likely to occur due to the bursting of the exchanger. This exchanger can be used as a steam generator in thermal energy producing installations utilizing PWR type reactors as heat sources. (auth)

11787 FLOW TWISTER. Calvin, J. N. (to Combustion Engineering, Inc.). US Patent 3,764,470. 9 Oct 1973. Filed date 4 Jan 1971. 6p.

A flow twister is described for the cooling fluid flowing longitudinally in channels between spaced parallel nuclear reactor fuel elements positioned laterally by intersecting grid members. The twister is a U-shaped metal sheet straddling one grid member at an intersection. The free ends of the U are folded on themselves and form two pairs of oppositely directed spirals and a pair of slots receiving the other grid member. The sheet is slotted in alignment with the pair of slots. The twisters direct cooling fluid inwardly toward and spirally around the adjacent fuel rod. (Official Gazette)

11788 POSSIBILITY OF FRACTURES IN LARGE COMPONENTS OF THE PRIMARY COOLANT LOOP OF PRESSURIZED WATER REACTOR NUCLEAR POWER PLANTS. Bergemann, W. (VEB Kombinat Kraftwerksanlagenbau, Berlin). Kernenergie; 16: No. 6, 183-193(Jun 1973). (In German).

The high concentration of fission product inventory in power reactors poses a potential threat which has to be reduced to minimum by a system of protective measures. One side of the protection measures consists in inquiring into the material stress, also during accidental situations (e.g. LOFT program, USA), and into the material behavior due to these stresses (e.g. HSST program, USA). Some of these stresses are discussed whereby it is not so much essential to find a quantitative estimate rather than to draw attention to some unanswered questions concerned, first of all, with the problems of transferability of laboratory results to a practical industrial plant as well as with the incomplete quantitative knowledge of special stresses (troubles, accidents). The possibilities of getting information by fracture mechanics is overestimated more often than not if this is neglected. The recent status of knowledge is characterized by the fact that incidences of fractures in systems of higher nominal diameter neither can safely be taken into account nor can be excluded. It has been found that a leakage in the primary coolant loop indicating the shutdown of the plant does not lead to fracture during the shutdown process until a quasi-critical crack configuration has been formed already during normal operation. This most unlikely circumstance will be minimized by further measures taken by the system of securing quality. 49 references. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 10598, 10599, 10618, 10619, 11762, and 12311.

11789 (AEC-tr-7428) DRY COOLING TOWER FOR THE 300 MW THTR NUCLEAR POWER PLANT SCHMEHAUSEN. Hirschfelder, G. (Vereinigte Elektrizitaetswerke Westfalen A. G. (VEW), Dortmund (F. R. Germany)). 1973. Translated from paper presented at VGB conference: power plant and environment, 1973. 20p. Dep. NTIS $3.00.

Due to the difficulties arising from the supply of make-up water in cooling towers it has become necessary to study other types of condensation and cooling systems. The design of the dry-type cooling tower to be constructed for the 300 MW THTR plant Schmehausen–Uentrop can be regarded as a step into the future and will provide valuable information on the cooling system itself and on its influence on the functioning of the plant. An abstract of this paper from the original language appeared in NSA as 28: 14384. (GE)

11790 (CONF-730668-1) USE OF NONMETALLIC MATERIALS WITH HIGH-TEMPERATURE GAS-COOLED REACTORS WITH SPECIAL REFERENCE TO HEAT EXCHANGERS FOR POWER AND PROCESS PLANTS. Hryniszak, W. (Clarke Chapman-John Thompson Ltd., Gateshead (UK)). 6 Jun 1973. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

From strategy for the development of nuclear steelmaking symposium; London, UK (6 Jun 1973).

The trend towards higher cycle temperatures in power production, leading to the use of closed-cycle gas turbines and the high-temperature heat which HTR's could provide for steelmaking create a demand for high-temperature heat exchangers. The possibility of using ceramic heat exchangers at temperatures above 1000°C is discussed in some detail. The dependence of the properties of ceramics upon the method of manufacture is stressed and the need for more development work emphasized. Experience already gained with Pyroceram, SiN, SiC, and Si-alones, based on Si/Al/oxygen/nitrogen, is described and important design criteria for nonmetallic heat exchangers are discussed. Finally, suggestions are made for future research and development. (21 figures) (UK)

11791 (CONF-730942-(P2), pp vp Sect. E5/6) VIBRATION RESPONSE OF REACTOR COMPONENTS IN HELIUM, CARBON-DIOXIDE, AND AIR. Whitton, P. N.; Hammill, W. J. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Significant acoustically induced dynamic stresses can occur in gas circuit components of nuclear reactors. Differences arise between reactors cooled by helium and carbon dioxide. The characteristics of a helium system are compared with existing carbon dioxide cooled reactors. The problem has been treated in three parts: differences in the normalized structures due to modified coupling between the acoustic field and structure; circular acoustic power generation in the two gases; and estimation of changes in sound pressure levels local to gas circuit structures. The combined effect of these three aspects upon the absolute response levels of gas circuit components is then assessed. 11 references. (auth)

11792 (CONF-730942-(P2), pp vp Sect. E5/7) GAS CIRCULATOR NOISE GENERATION CHARACTERISTICS. A Comparison of the Effects of Helium, Carbon Dioxide, and Nitrogen. Drake, M. E. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Failures have occurred in some of the U. K. power stations due to fatigue of reactor gas circuit components induced by the noise

generated by the coolant gas circulators. It is important that the dynamic stresses in these structures are appreciated at an early stage in the design and construction of a reactor. The sound pressures and frequency spectra of the noise generated by the circulators are important parameters affecting these dynamic stresses. The basic characteristics of noise generation are discussed. The effectiveness of these characteristics depends on the circulator rotor tip Mach number, and it is important to know how these characteristics vary over the Mach number ranges pertinent to gas cooled reactors. Data presented are selected from a large number of measurements taken of the sound pressures generated by a variable speed centrifugal circulator operating in helium, nitrogen and CO_2 over a wide range of densities, temperatures and speeds. A wide range of Mach numbers has thus been encompassed with these gases from which their characteristics of noise generation are compared. Mention is also made of the influence of different gases on the propagation of modes through the outlet duct of a centrifugal circulator. Theories and measurements presented to date have only considered axial fan circulators, and relatively simple outlet ducts. The theory and measurements referred to consider the propagation of modes through a radially symmetric outlet annulus. 11 references. (auth)

11793 (CONF-730942-(P2), pp vp Sect. F1/9) SIMPLIFIED METHOD OF RESTRAINED DISTORTION ASSESSMENT OF REACTOR CORE COMPONENTS. Pitchford, B. E.; Kinkead, A. N. (Atomic Energy Establishment, Winfrith, Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Owing to the appreciable variations in intensity of fissile power and fast neutron damage flux which occur in prismatic components of reactor cores under steady state operating conditions, it is necessary to assess the stresses and deformations arising. These deformations may become unacceptably large in graphite structures in which the temperature and damage flux variation is unsymmetrical with respect to the geometry of the component. Even with the simplifying assumption of an axi-symmetrical core power loading the problem is complicated by the wide variations obtained in both axial and radial directions within any single fuel carrier or reflector structure. A computer code CURVO has been written using a "spring and plate" analogy to evaluate both the free and the restrained distortion behavior of such components in which variation of temperature and dose dependent structural parameters can be taken into account throughout the residence time of the component in the reactor. An example of the application of this analysis to a vertical reflector column bounding the core of the Dragon Reactor Experiment is presented in some detail together with comparison of the predicted and observed distortions. A derivation of the method has been used in the preparation of a computer subprogramme PISC for use in conjunction with the finite element code STAG to predict post-irradiation distortion of cut sections of fuel element structures. Brief mention is also made of the application of the method to fuel element bowing problems. 4 references. (auth)

11794 (CONF-730942-(P2), pp vp Sect. F4/1) GAS COOLED REACTORS WITH TWO SUPERPOSED COOLING LOOPS IN EACH CAVITY: CONSEQUENCES FOR THE PRIMARY CIRCUIT STRUCTURES AND THE GENERAL ARRANGEMENT (APPLICATION TO HIGH TEMPERATURE REACTORS). Tilliette, Z. (CEN de Saclay, Gif-sur-Yvette, France). 1973. (In French).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The main feature of the proposed 2000 MW(e) design is the layout of two distinct, superposed cooling loops in each cavity. This cavity arrangement involves important consequences on the whole reactor design, the fuel handling and storage, and even the general arrangement of the plant. In addition to general advantages such as improved plant or reactor reliability, improved operation flexibility, easier extrapolation to high power ranges, reduced pumping power, greater safety, this design highly affects the structural aspect of the main components. The prestressed concrete pressure vessel and its internal structures take a great advantage of the present reactor design. Its general arrangement looks favorable and the void ratio in the PCRV wall appears low. The closures of the cavities, double indeed, have a relatively limited diameter. An increase of the helium pressure by 15 to 20 per cent could be easily taken into consideration. The PCRV linear and its thermal insulation are almost everywhere in contact with helium at 250°C and accessible for inspection. The hot ducts are actually removable and little concerned by thermal transients. (auth)

11795 (CONF-730942-(P2), pp vp Sect. F4/2) COMPREHENSIVE ANALYSIS OF THE BEHAVIOR OF PRIMARY CIRCUIT COMPONENTS UNDER STATIC AND DYNAMIC LOADS FROM A PRESSURIZED GAS. Baylac, G. (Electricite de France, Paris); Michel, L.; Leboulanger, R.; Copain, A.; Roche, R.; Vrillon, A. 1973. (In French).

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

After several years of operation, it appeared that blades of some cascades welded in bends of the high temperature, high pressure primary circuit of a gas cooled nuclear reactor presented ruptures and cracks. It was then necessary to undertake a comprehensive review of the permanent and fluctuating loads due to the flow of high temperature pressurized gas in order to know the possible causes of these failures (mechanical or thermal stresses or stall-flutter instability) and to find out solutions. New computational methods are described. The first method was a computation of pressure induced strains in naked elbows (without welded blades) by a finite element method. The stresses calculated in the elasto-plastic field were analyzed to define whether the elbow had to be reinforced by welded blades on the inner side or not. Then the validity of the assumed hypothesis was controlled by a computation of the collapse load of two naked elbows. The second method was a determination of the aerodynamical loads on the blades. The basis of this determination is a finite difference computation of the flow field in a naked elbow through a Prandtl's mixing length model of turbulence in order to find out the velocity profile around blades. These computational methods were both checked by mock-up tests. A good agreement between the experimental and calculated collapse load was obtained. The head loss coefficient of the elbow equipped with a new cascade was of the expected value. 7 references. (auth)

11796 (JUL-932-RG) INFLUENCE OF THE UPPER CAVITY ON NEUTRON PHYSICS OF THE PEBBLE-BED REACTOR. Maly, V. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Mar 1973. 94p. (In German). Dep. NTIS (U.S. Sales Only) $6.75.

In the pebble-bed reactor there is a cavity between the upper reflector and core. In the case of the OTTO (Once Through Then Out) reactor with its strongly asymmetric flux and power profile, detailed knowledge of flux and power distribution in its neighborhood is of particular interest. The cavity effect has been investigated for the process-heat reactor PR-500 by applying the 2D S_N transport code. A comparison of the results achieved by the diffusion and transport approximation has been performed. The influence of the real structure in the upper reactor regions on the neutron distributions has been discussed in detail. There is a strong radial flattening of neutron flux profile and of power density in the vicinity of the cavity. The cavity influence on the effectivity of control rods has been investigated. It appears that the normal power-load scheme can be controlled merely by the control rods situated above the pebble-bed. (auth)

11797 CONSTRUCTION PLANNING AND REALIZATION OF THE THTR SCHMEHAUSEN. Heinlein, H. (Brown, Boveri und Cie AG, Mannheim, Ger.). pp 44-52 of VGB-bautagung Dortmund 1972. Essen; Vereinigung der Grosskraftwerksbetreiber eV (1972). (In German).

From VGB conference on construction technique in thermal power plants; Dortmund, Germany (27 Sep 1972).

The history of the THTR Schmehausen is briefly reviewed up to its present state today. In addition, a description is given of the whole plant and of the exact details on the outcome of the reactor licensing, the construction planning, and single building parts such as the primary part, reactor halls, and pre-stressed concrete containers. (GE)

11798 DETECTION AND LOCATION OF FAILED FUEL. Downs, T.; Wood, J. T. (General Electric Co. Ltd., Whetstone, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 437-442(Oct 1973).

The techniques used for sampling and measuring fission product activity in the coolant of reactor systems, for detection of fuel failure, are described. A brief outline is given of detection by electrostatic precipitation, delayed neutron monitoring, and direct gamma activity monitoring. The system for Magnox reactors based on electrostatic precipitation and the PFR system which comprises two independent systems both based on delay neutron monitoring are discussed. Brief reference is made to methods for advanced and high temperature gas-cooled reactors. (UK)

11799 GGA HIGH TEMPERATURE GAS-COOLED REACTOR. A General Discussion. Landis, J. W. (Gulf General Atomic, Inc., San Diego, CA). J. Brit. Nucl. Energy Soc.; 12: No. 4, 367-383(Oct 1973).

In a discussion on the present state of high temperature gas-cooled reactor technology, the environmental advantages of the system are outlined and followed by a description of operating experiences with Dragon, AVR, Peach Bottom, Fort St. Vrain, and the THTR. The essential features of the 3000 MW(t) and 2000

MW(t) commercial HTGR's offered by Gulf General Atomic are described and the present commercial position is outlined. A brief summary of HTGR development in Europe and Japan is followed by a consideration of advanced versions, i.e., the direct cycle type, and HTGR's for process heat and for hydrogen production. Later advanced concepts, the GCFR and the thermonuclear fusion reactor concept Doublet, are also assessed. In conclusion, a forecast of the future of helium cooled reactors includes a schedule for their development. (UK)

11800 BEHAVIOUR OF IODINE SPECIES IN THE WINDSCALE AGR. Hillary, J. J. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 443-446(Oct 1973).

Several fuel pins with deliberately defective cans were irradiated in the Windscale AGR. Associated with these experiments, a ^{131}I monitoring programme was carried out, in which CO_2 coolant from channels containing this experimental fuel, and from other channels, was passed through samplers that permitted the physical and chemical form of the iodine to be assessed by selective filtration sorption or reaction. The release of iodine from operational fuel pin failures was also studied. A separate experiment, in which methyl iodide was injected into the reactor coolant circuit, was carried out. The results indicated that the ^{131}I release is principally in the form of methyl iodide. The iodine has a chemical decomposition half-life of 2½ min, similar to that of methyl iodide injected into the coolant circuit. This half-life corresponds to a value of 4500 for the ratio of steady-state ^{131}I release from the fuel pin to that remaining gas-borne, which is the decontamination factor. It also corresponds to a deposition velocity of 0.02 cm/sec to the cooler parts of the heat exchangers where iodine was found to be deposited. (UK)

11801 RETENTION AND CONTROL OF FISSION PRODUCTS IN A HIGH TEMPERATURE GAS-COOLED REACTOR. Ashworth, F. P. O. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 421-422(Oct 1973).

A very brief explanation is given of the principles of the control of fission products in the high temperature reactor. The fission products are retained by layers of silicon carbide and pyrolytic carbon and the consequences of defects in the fuel particles is discussed. (UK)

11802 GREAT FUTURE FOR THE HIGH-TEMPERATURE REACTOR. Process Heat for Chemistry and Technology. Electricity from Helium Turbines. Rudzinski, K. Elektrotech. Z., B; 25: No. 1, 11-12(1973). (In German).

A short review is given on air cooling and safety, on spherical or block elements, and on industrial political consequences of HTGR type reactors. (GE)

11803 1160-MWe HTR IN WEST GERMANY. Com. Naz. Energ. Nucl., Notiz.; 19: No. 7, 46-49(Jul 1973). (In Italian).

The history and main specifications of the 1160-MW(e) power plant scheduled to be built under Germany's Fourth Nuclear Plan are presented. (auth)

11804 HIGH TEMPERATURE REACTOR WITH HELIUM TURBINE. State and Aim of the Works for the HHT Project Given at a Hearing In Jülich. VDI (Ver. Deut. Ing.) Nachr.; 26: No. 40, 6-7(1972). (In German).

An outline is given of the development of a gas cooled reactor and helium turbine single-cycle system for the high temperature reactor with helium turbine project (HHT). The data for the capacity limits of the cooling water supply and for the decrease in costs of the whole plant as compared to the steam power plant are to be critically estimated as they caused a considerable controversy in the public discussion held in Juelich on 18th September 1972. (GE)

11805 FUEL ELEMENT STRESSES AT DISCONTINUITIES AND INTERACTIONS BY FINITE ELEMENTS IN TWO DIMENSIONS. Alujevic, A.; Head, J. L. (Imperial Coll. of Science and Tech., London). Atomkernenergie; 21: No. 2, 75-80(1973).

A two-dimensional "body of revolution" finite element computer program developed for the analysis of time dependent stresses in High Temperature Reactor fuel elements during irradiation is described. The theory, which allows for thermal expansion, irradiation-induced shrinkage and creep, is given and a computer code listing and some typical results are included. (GE)

11806 SAFETY TESTS FOR SCHMEHAUSEN USE MODEL OF PRESSURE VESSEL. Energy Int.; 9: No. 9, 21-22(Sep 1972).

The prestressed concrete pressure vessel for the THTR-300 reactor at Schmehaasen is described. The results of overload safety tests on a model of this vessel are discussed. (JWR)

11807 OPERATION EXPERIENCE OF TOKAI NUCLEAR POWER STATION. Inoue, Y. (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo; 19: No. 1, 9-13(Jan 1973). (In Japanese).

Tokai nuclear power station commenced to load initial fuel on April 26, and attained criticality on May 4, 1965. On November 10 in the same year, first electricity output was transmitted. From the end of 1965 to the beginning of the next year, an accident of steam leakage occurred from the superheater pipes of a heat exchanger, a throttle valve of a steam turbine was broken due to vibration, and rectifying plates inside a gas duct bend were broken due to vibration. From July 1967, full power operation was commenced, but in the last of December, breakdown of a gas recirculator due to vibration fatigue occurred, and the plant was shut down during three months. In August 1968, leakage of steam occurred sporadically from the bends of low pressure vaporizing tubes of the SRU. For coping with the problem of oxidation phenomenon of steel in CO_2 atmosphere, from the middle of September in 1968, reactor outlet temperature was reduced from 386°C to 360°C, and electric power was also reduced to 130 MW. Periodical inspection was performed 5 times up to 1972. Released gaseous radiation has been lower than that from light-water type reactors. (JA)

11808 OTTO-CONCEPT FOR HIGH-TEMPERATURE REACTORS. Teuchert, E.; Wolf, L. Energ. Tech.; 25: No. 9, 236-237(1973). (In German).

The special points and advantages of this process, developed in the nuclear research plant Juelich, compared to the manifold refuelling with spherical formed fuel elements are described. This type of refuelling considerably facilitates the reactor control. (GE)

11809 2300 MW NUCLEAR POWER STATION WITH HIGH-TEMPERATURE REACTORS. Schweiz. Bauztg.; 91: No. 17, 402-404(26 Apr 1973). (In German).

A nuclear power station with two enriched uranium/thorium high temperature reactors with helium gas cooling commences building in 1973 to come into commercial operation in 1979 in USA. A cross-section of a reactor, and a schematic diagram of the helium and water/steam circuits are shown and described. Generators are driven by three-stage turbines taking high pressure steam at over 500°C. The net efficiency is 38.6% for the two 1160 MW installations. (INIS)

11810 FUEL CARTRIDGE SUPPORT FOR A NUCLEAR REACTOR. Bujas, R. (to Commissariat a l'Energie Atomique). French Patent 2,138,411. 25 May 1971. 6p. (In French).

A support device was developed for high temperature nuclear reactor fuel cartridges contained in a vertical channel provided in the prismatic graphite block, the length of this channel being equal to the length of the cartridge. The device is provided with a raised radial finned surface which is partly supported by the inner surface of the vertical canal and which extends in a direction parallel to the axis of this channel. The device is also partly supported by the outer surface of the fuel cartridge which fits coaxially into the channel, the fins of the channel and those of the cartridge fitting together. These fins are interrupted along their lengths in such a way that each fin of the channel corresponds to a fin of the cartridge, the sum of the lengths of the fins corresponding to the total common length of the cartridge and the channel. (FR)

11811 IMPROVEMENT FOR GRAPHITE ASSEMBLIES EXPOSED TO NEUTRON IRRADIATION. Galy, A.; Rappeneau, J. (to Commissariat a l'Energie Atomique). French Patent 2,132,587. 9 Apr 1971. 6p. (In French).

A method is described for reducing the stresses or modifying the relative displacements between parts of an assembly exposed to neutron irradiation, at least one of these parts being composed of graphite. A special feature of the method is that the variations in size are matched by combining parts having given contractions with graphite parts whose contractions are fixed by the heating rate during graphiting. The greatest heating rate possible is selected for the part for which the greatest increase in contraction is desired. (FR)

11812 COOLANT TREATMENT PLANTS FOR WINDSCALE AGR TEST LOOPS. Design, Development, and Operating Experience. Brierley, G. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 463-467 (Oct 1973).

The design principles and operational experience for the plants associated with the control of coolant composition in two of the loop circuits of the Windscale AGR are described. Each plant is capable of independent operation, its function being to oxidize CO and H_2, and to remove excess H_2O. Facilities are also provided for injecting CH_4, CO and other possible additives. The plants have operated satisfactorily and in conjunction with in-core loop circuits provide a facility in which full-size fuel pins for commercial AGRs can be irradiated in a range of coolant environments. (UK)

11813 PHYSICS DESIGN OF THE 300 MW(e) GAS-COOLED FAST BREEDER REACTOR. Cerbone, R. J. (Gulf General

Atomic, Inc., San Diego, CA). J. Brit. Nucl. Energy Soc.; 12: No. 4, 409-414(Oct 1973).

A summary is given of the physics design of the Gulf General Atomic (GGA) 300 MW(e) gas-cooled fast breeder reactor demonstration plant. The calculational methods and nuclear data used in the design of fast reactors at GGA are presented and the principal physics parameters are discussed. Finally, a brief discussion of large GCFRS is given. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 11762, 12006, 12009, 12018, 12020, 12021, 12184, 12185, and 12194.

11814 (BARC/I-172) SEAL FOR COOLANT CHANNEL END CLOSURE: A DESIGN STUDY. Kakodkar, A.; Mehra, V. K.; Dighe, U. S.; Varshney, S. C. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 43p. INIS.

A design study was conducted to get a detailed understanding of the functioning of CANDU seal disc. The analysis is based on the model which considers the disc as a composite body made up of a large number of circular rings. This method allows variations in thickness, fillet radii, etc., to be accounted with reasonable accuracy. The computer program used in this study can also be used for analysing similar discs for 500 MW(e) reactors. A preliminary analysis of a tubular metal to metal seal has also been included. (auth)

11815 (CONF-730942-(P2), pp vp Sect. F1/8) INTERNAL SUPPORTING STRUCTURES OF THE "CIRENE" REACTOR CORE: RESULTS OF STATIC STRESS ANALYSIS FOR A NORMAL CONDITION. Caruso, S.; Genco, M.; Palmero, A. (Progettazioni Meccaniche Nucleari, Genoa). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The method and the results of an elastic static analysis of the CIRENE reactor core supporting structures are presented. The structures of "CIRENE", a pressure tube type reactor, are composed of the following parts: the central structure, consisting of 4 vertical axes circular plates, joined together by tubes arranged essentially according to a square pattern; two stiffness rings connected with the periphery of external plates; and the moderator tank wall joined with internal plates. The structural material is steel with the exception of the calandria tubes portions between the internal plates which are Zircaloy. The analysis method used starts from temperature distribution and mechanical loads and gives stresses and strain distribution on structures. The approach used consists in studying some structures analytically and other ones numerically according to the finite element method. The peculiarity of the method consists in the original manner through which the joint tube-plate is studied. A new finite element (CUP element) is introduced in order to reproduce the local elasticity of the tube-plate joint in the best possible way and to study its influence on general stresses and strain distribution of structures. 6 references. (auth)

11816 (CONF-730942-(P2), pp vp Sect. F2/1) FRACTURE BEHAVIOR OF THE PRESSURE TUBES FOR ADVANCED THERMAL REACTOR. Fujimura, T.; Shibata, K. (Japan Atomic Energy Research Inst., Tokai). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In an advanced thermal reactor, for example the JATR reactor of Japan, calandria structure is used for the reactor pressure system. This structure has many advantages, while with its own demerits. One of them is the employment of a new material, such as Zr-Nb alloy, for pressure tubes, which are important parts to contain the reactor core system. Zr-Nb alloy has low toughness compared with other structural materials, and therefore the fatigue crack propagation and fracture behavior of Zr-Nb alloy have been studied in cyclic pressure loading test with the full size pressure tubes with different types of notches to evaluate the structural integrity under reactor operation. Stainless steel heads were connected respectively to the pressure tube ends by roll jointing. The notch was made at the center of the tube length in longitudinal direction by machining: notch A, 10 mm long, 1 mm in depth; B, 20 mm long, 1 mm in depth; and C, 3 mm long, but penetrating through the wall. Cyclic pressure loading test was made at 100 to 180 kg/cm^2 in 10 or 20 cpm. Crack growth from the notch root was measured by optical and electric techniques. Cyclic loading tests were continued until the fatigue crack grew to critical size and the fast fracture occurred. The crack propagation rates obtained in the experiments were arranged in terms of the stress intensity factor K. 5 references. (auth)

11817 (CONF-730942-(P2), pp vp Sect. F2/3) EFFECTS OF HYDROGEN CONTENT, TEMPERATURE, AND CRACK CONFIGURATION ON FATIGUE CRACK PROPAGATION AND UNSTABLE FRACTURE BEHAVIOR OF Zr-2.5 Nb PRESSURE TUBE. Kusumoto, S. (Hitachi, Ltd., Ibaraki, Japan); Nishioka, A.; Maki, H.; Usami, S.; Hayashi, K.; Ando, Y. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The unstable fracture behavior was studied on the Zr-2.5Nb pressure tube intended to be used in the heavy water moderated and light water cooled reactor, "FUGEN", from the viewpoints of the effect of hydrogen content, temperature and crack configuration. The test methods are as follows: (1) the internally pressurizing test on the pressure tube, (2) the ring tensile test and (3) the bending test using a small crescent shaped specimen. The methods (2) and (3) were developed in anticipation of their usefulness for surveillance of the pressure tube material served in the reactor. The hydrogen content of the specimens was ranged from 5 to 300 ppm, the test temperature was changed from a room temperature to 300°C and the various crack configurations, that is the different sizes in length and depth, were studied. The effects of these parameters were observed from the viewpoints of the fracture strength, the number of cycles to crack initiation, the fatigue crack growth rate and the fracture behavior. The results were examined by application of the linear fracture mechanics, and under small scale yielding condition, the effects of the difference of the test methods ((1), (2) and (3)) could be eliminated by using the stress intensity factor. 9 references. (auth)

11818 (CONF-730942-(P2), pp vp Sect. F6/5) EXPERIMENTAL AND ANALYTICAL CORRELATION OF LOCAL DRIVING FORCES AND TUBE RESPONSE IN LIQUID FLOW INDUCED VIBRATION OF HEAT EXCHANGERS. Mirza, S.; Gorman, D. J. (Univ. of Ottawa). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A thorough experimental and analytical study of liquid cross-flow induced vibration in tube bundles is described with geometry and flow rates of current interest. Techniques have been developed for measuring local driving forces, tube response, and development of velocity profiles throughout the bundle. As expected, driving force and response amplitudes are random in nature, and are correlated using the linear random tube vibration theory as described in the above reference. A water tunnel consisting of a rigid horizontal duct, 6" in width and 36" deep, was constructed. Water is circulated through this duct, past a 10" long test section of vertical tubes, and returned over a high level weir to the pump system. Equilateral triangular arrays, of ¾" O.D., by 066" wall stainless steel tubes, are tested with 1" and ¾" pitch distances. Tubes are submerged and simply supported with lucite end plates. Rotation of the end plates through 90 degrees permits measurements to be taken with flow parallel to one of the equilateral triangular array bases (in-line flow), or normal to one of the bases (out-of-line flow). Displacement is measured with accelerometers mounted inside the tubes. 5 references. (auth)

11819 (EBO-310-24) PROJECT OF ROUTINE MEASUREMENTS OF NEUTRON FLUX DENSITY AND NEUTRON DOSE IN THE CORE OF REACTOR KS-150. Rana, S. B. (Atomova Elektraren, Jaslovske Bohunice (Czechoslovakia)). 1971. 26p. (In Slovak). INIS.

The problems are discussed of measuring the neutron flux and neutron dose in power reactors as related to fuel economy and operation safety. Current possibilities are outlined of studying the neutron flux in a heavy-water reactor of the KS-150 type, and the justification is given of using a wire rather than foils when measuring the neutron flux in large reactors at zero power. Measuring systems utilizing miniature self-feeding neutron detectors were proposed for continuous neutron flux measurement in the KS-150 reactor; a system with movable sensors was found to be more advantageous than one with fixed sensors. Detection of selected radioisotopes generated in a thermocouple wire is a good means of additional determination of neutron flux or dose in the KS-150 reactor. (auth)

11820 (INIS-mf-782) EXPANDED JOINTS FOR CALANDRIA TUBES AND COOLANT CHANNEL ASSEMBLIES IN CANDU TYPE OF POWER REACTOR. Kapur, R. K.; Arya, R. C.; Krishnan, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The construction of CANDU type power reactors involves production of a large number of expanded joints, such as, joint be-

tween calandria tube sheet and tube, coolant tube joint, etc. The specific requirements for each joint, materials, equipment, preparations, procedure and specific problems are discussed. The criteria explained are consistency in quality and dimensional control, simplicity and economy in production, ability to counter stresses resulting from service conditions, etc. Based on the experience at the Rajasthan Atomic Power Project, which consists of CANDU type power reactors, an assessment of the consistency demanded in construction of reactor pressure vessels is presented. (INIS)

11821 (INIS-mf-783) SALIENT FEATURES OF CIVIL CONSTRUCTION IN REACTOR BUILDING AT RAPP. Part II. Manufacture and Quality Control of Concrete. Prasad, K.; Singha Roy, P. K.; Sukhthankar, K. D. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

In the reactor building construction at the Rajasthan Atomic Power Project (RAPP) the bulk of material used is concrete. The salient features of manufacture and quality control of concrete are described. The reactor building construction envisages the usage of some 12,000 m^3 of normal density concrete, some 1000 m^3 of heavy density (min 220 lbs/cft) hematite concrete, and some 1000 m^3 of high strength prestressed concrete (500 psi). Minimum shrinkage is realized by lowering cement and water contents using a suitable water reducing admixture wherever advisable and controlling temperatures in containment structures—both the heavy concrete containment for the calandria (reactor) vault and the final normal concrete containment forming the building envelope. The specifications and requirements of materials—cement, aggregates, admixtures etc. used for the concrete, the batching and mixing procedure, the criteria for mix design, the special requirements and materials for the manufacture of heavy concrete and low temperature concretes for containment structure and the typical mixes used are described. The parameters and degrees of quality control are discussed. (INIS)

11822 (INIS-mf-784) SALIENT FEATURES OF CIVIL CONSTRUCTION FOR REACTOR BUILDINGS AT RAPP SITE. Part I. Civil Construction. Prasad, K.; Singha Roy, P. K.; Rahalkar, B. D. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The procedures employed in handling, installation and alignment of main reactor components such as calandrias, end shields, end shield rings, dump tank, expansion joint, shield tank etc., of Unit-1 of Rajasthan Atomic Power Project are described. The components, varying from 30 tons to 120 tons, involve considerable fabrication work at the reactor site shops prior to their lowering into the reactor building. Techniques are highlighted with reference to bringing the components to the site, rolling inside the reactor building, mounting on a special super-structure placed on the carriage with the help of a winch, and avoiding any tilting due to heavy weight etc. In the alignment of reactor components, special optical instruments used are mentioned. Based on the experience of Rajasthan-1 Reactor, it is recommended that prior to the shipment of components, a thorough inspection should be made at the manufacturer's shop to avoid the time loss on the rework of the components at the reactor site. (INIS)

11823 (INIS-mf-786) INSTALLATION AND ALIGNMENT OF HEAVY REACTOR COMPONENTS IN UNIT 1 OF RAJASTHAN ATOMIC POWER PROJECT. Chaturvedi, V. K.; Khanna, R. K.; Krishnan, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The Rajasthan Atomic Power Project has two nuclear power reactors, heavy water moderated and cooled, with uranium oxide fuel. The salient features of civil engineering construction for the reactor building are described. The special construction requirements and the actual construction procedures adopted in excavation, foundation grouting, containment building, building drainage, and reactor vault construction including heavy density hematite concrete are explained. The building houses the reactor core and is the final containment effecting reduction of radiation to safe limit outside and has to be pressure tight against any accidental radioactive discharges. The concrete containment therefore has to be free from any crack due to shrinkage and leak proof under the pressure of 6 psi. The heavy concrete work in the calandria vault, the low temperature concrete in the containment perimeter wall to minimize shrinkage, the 39.62 m (130 ft) hemispherical prestressed concrete dome, the end shield grouting with specially designed non-shrink grouts and restraints to eliminate any movement of the shield during grouting, the 106.7 m (350 ft) high stack to release gaseous discharges from the building to safe height above ground, the thermal insulation on the outside of the inaccessible reactor building dome, and the 1.82 M litres (4 lakh gallons) capacity pre-stressed concrete dousing tank for Unit-II are all unique. Salient features of all of them have been discussed. (INIS)

11824 (INIS-mf-787) CIVIL ENGINEERING ASPECTS OF REACTOR CONSTRUCTION WITH PARTICULAR REFERENCE TO RAJASTHAN ATOMIC POWER PROJECT. Vengurlekar, V. R.; Kulkarni, N. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 19p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The Rajasthan Atomic Power Project has two nuclear power reactors, heavy water moderated and cooled and with uranium oxide fuel. The experience in the construction of buildings and structures for the twin units of 200 MW(e) each of RAPP is described. The civil engineering aspects of the reactor construction are highlighted as the construction period for major civil works takes about 40 to 50% of the project construction time. Suggestions regarding the improvements in the construction methods to achieve the desired reduction in construction time are made. The reactor building of RAPP consists of (i) containment shell comprised of a cylindrical R. C. shell of 39.624 m diameter capped by a hemispherical prestressed concrete shell, (ii) calandria vault in heavy concrete which houses the reactor core, and (iii) internal slabs and walls supported on structural steel framework. Functional requirements of reactor building construction and the major criteria, such as structural integrity, leak tightness, voids in concrete, uniformly high quality construction, construction in planned sequence to utilize stage by stage the portions built, etc., are discussed. (INIS)

11825 (INIS-mf-799) MANUFACTURING PROBLEMS IN CALANDRIA. Patwardhan, V. M.; Mahindru, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Problems encountered during the manufacture of the calandria, the main reactor vessel in CANDU reactors, are presented. The main requirements in particular to calandria assembly are reported and special care has been taken to maintain clean conditions throughout the fabrication process. Two calandrias have been fabricated in Canada and they are installed at the Douglas Point Generating Station and at the Rajasthan Atomic Power Station, Unit-1 respectively. The third calandria for Rajasthan Atomic Power Project Unit-2 is being fabricated in India and stages of fabrication which are different from the earlier ones are described. Highlights of special fabrication requirements which the Indian Industry is called upon to meet are summarized. (INIS)

11826 (INIS-mf-800) FABRICATION OF REACTOR COMPONENTS. Rao, L. H. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The fuel transfer system forms part of the CANDU Reactor System and consists of mechanical handling devices which load fresh nuclear fuel into, and receive spent fuel or partly spent fuel from reactor fuelling machines. The environment in which this equipment has to operate and the handling of hot (radioactive) fuel bundles pose unique problems of design, material selection, and fabrication. A review of system design parameters, material selection details, and heat-treatment and surface treatment operations which are dictated by the physical properties of the fuel is presented. The fuel which is fabricated under strict quality control methods has to slide at a velocity of 10 ft/min through a total of about 60 ft at room temperature conditions and negotiate about twenty four gaps. The total movement of fuel involves 75 ft over Zircaloy and 45 ft over steel tube surfaces. Details of alignment problems encountered during shop-fabrication and testing and later in actual installation are discussed. Operations such as welding, machining, heat-treatment, nitriding, etc., required on the component and the sequence in which these are to be carried out are discussed in the light of functional requirements. An outline of the simplification plans of the system equipment, improving performance, and reducing manrems required for maintenance or operation, is also included. (auth)

11827 (INIS-mf-801) DESIGN AND MANUFACTURING CRITERIA FOR PUMPS USED IN RAPP TYPE STATIONS. Narayan, K.; Gujar, P. V.; Chatterjee, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The major pumps used in the Rajasthan Atomic Power Plant type of stations in India are given. The primary heat transport and condenser water pumps are studied in detail. For CANDU reactors, the coolant is pressurized heavy water and the primary heat transport pump operates at a suction pressure of above 1200 psig and at a temperature of 505°F. The pump has to be suitable for continuous running for 8000 hrs and the material used for construction should not be impaired due to radiation damage. The pump design should also take into consideration the rate of cooling of about 30°C/min. Carbon steel and stainless steel are the materials used for the construction of the pumps. A shaft development program for these pumps is currently being discussed at the Bhabha Atomic Research Center, Bombay, India. The composition of materials used for the condenser pumps at the Rajasthan and the Madras Atomic Power Plants are also given. Pump castings and impellers are discussed in detail. Problems in the manufacture of some of the pumps have been briefly reviewed. (INIS)

11828 (INIS-mf-802) PROBLEMS IN THE MANUFACTURE OF STEAM SURFACE CONDENSERS FOR NUCLEAR POWER STATIONS. Nagi, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The problems encountered in the manufacture of steam surface condensers for the Rajasthan reactors are discussed. Some of these are: i) welding of 10′ × 10′ × 3″ thick square flanges with constant effects to minimize the weld distortion, ii) manufacture of expansion joints wherein welding of very thin plates into an intricate shape in involved, iii) drilling of a large number of support plates especially in the absence of tube sheets, and iv) fabrication of water-boxes of odd shapes. The confidence developed and the experience gained by the Indian industries in the manufacture or large steam surface condensers is proved by the fact that the RAPP-1 condenser could not be fabricated in the country but the RAPP-2 condensers have been fabricated completely indigenously. Presently, preparatory work for manufacture of condensers for the Madras Atomic Power Project is in progress. (INIS)

11829 (INIS-mf-803) STEAM GENERATORS AND OTHER HEAT EXCHANGERS FOR RAPP AND MAPP. Chatterjee, S. K.; Mitra, M. L. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A description of the steam generating equipment at Rajasthan Power Plant, India, consisting of eight steam generators is given. The design data of some of the heat exchangers used in the reactor building are presented. Monel is the material used for the tubes and the channel covers are of carbon steel and welded to the heavy water headers. The thermal design of the preheater section and steam generating section are also given. The mechanical design has been as per section VIII and section III of ASME code. A complete stress analysis has been carried out for various conditions of operations and transient cycles. The welded tube end joint having minimum "leak path" was selected and the destructive testing of large number of sample welds was carried out. Special welding equipment was developed for making the tubes and welds. Special techniques were employed for dissimilar metal welding. Dye-penetrant, magnaflux, radiographic, and ultrasonic methods were adopted for the inspection of these welds. (INIS)

11830 (INIS-mf-805) EXPERIENCE IN MANUFACTURE OF MAJOR NUCLEAR EQUIPMENT. Arumughum, P. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 14p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

While substantially all equipment required for the first unit of Rajasthan Atomic Power Project were imported, decisions were taken to organize the manufacture of some of the auxiliary equipment in India with a view to gain adequate experience preparatory to taking larger responsibilities for future power reactors. The second unit of the Rajasthan Atomic Power Project represents a further major effort towards Indian manufacture of most of the nuclear equipment and large amount of equipment required for the conventional portion of the plant. The Madras Atomic Power Project derives the benefits of this effort and the experience gained in this effort is presented. A list of major equipment planned for supply from Indian sources for the various reactor units in RAPP and MAPP is presented. Employment of adequate engineering personnel, management coordination with the manufacturers, development of techniques for production control, and prompt communication between the purchaser and manufacturers are some of the methods developed for controlling the schedules and the cost of nuclear equipment. (INIS)

11831 (INIS-mf-806) STEELS FOR INDIAN CANDU TYPE NUCLEAR POWER REACTOR AND SOURCES OF SUPPLY. Arumughum, P. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 17p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Steel in different forms constitutes the most important raw material required for various components in the CANDU type nuclear power reactor. Different types of carbon steels and corrosion resistant stainless steels are required in large quantities besides small quantities of special and high strength alloy steels for a variety of other applications. Most of the requirements are beyond the range of manufacture in India and different sources of supply have to be considered. Efforts for development of manufacturing certain categories of steels have also been initiated recently. Different categories of steels required for different components and the problems associated with establishing new sources of supply are described. Specifications of the products to meet the requirements of components in India are given. Problems of establishing quality requirements and quality surveillance arrangements are also reviewed. Suggestions for evolving a meaningfully efficient procedure for satisfactory procurement of these special materials are also presented. (INIS)

11832 (INIS-mf-810) MANUFACTURE OF SHIELDING AND SEALING PLUGS. Sanatkumar, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The manufacture of shielding plug and sealing plug assemblies pose challenging problems since they have to be operable under heavy water at high pressure and temperature conditions. By machining these plugs to close tolerances, a very high degree of reliability can be achieved. During the fabrication of shielding and sealing plugs for RAPP-2, solutions were found to several problems encountered during the manufacture. They are: broaching of splines, spark eroding of the form holes, soft nickel plating of the sealed disks, and surface hardening of the components. Plans are also under way to manufacture inconel springs in India, which completes the manufacture of shielding plugs and sealing plugs. (INIS)

11833 (INIS-mf-811) LOCAL STRESS RELIEVING OF END SHIELDS FOR UNIT 1 OF RAJASTHAN ATOMIC POWER PROJECT. Chaturvedi, V. K.; Khanna, R. K.; Krishnan, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The formidable task of partial local stress relieving of repaired leaky weld joints in the end shields when the shields had already been stress relieved, machined, and helium leak tested at the manufacturer's shop has been dealt with. Before resorting to actual stress relieving, mock-ups were carried out to determine distortion effect on the adjoining lattice bores and also to finalize the procedure. However, distortions occurred in a number of lattice tubes which gave rise to another challenge involving rectification of the bore attitudes to bring them within the drawing tolerances. The distorted lattice bores were machined oversize to remove the ovality and eccentricity. (auth)

11834 (INIS-mf-812) FABRICATION AND ERECTION OF PIPING FOR PRIMARY HEAT TRANSPORT MAIN CIRCUIT. Sethi, G. S.; Kapoor, V. P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The Primary Heat Transport (PHT) main circuit in the Rajasthan Atomic Power Station consists of piping between the two banks of steam generators located on either side of calandria. Heavy water coolant is pumped through the pressure tubes of the calandria to transport heat from the fuel under fission. The erection of piping between the steam generators and reactor headers, erection of the headers, primary coolant pumps, and the erection of feeders between the headers and coolant channels is described. The various problems faced during bending and stress relieving of feeders, lapping and burnishing of grayloc hubs, welding of feeders, feeder inspection in mock-up stage, installation of feeders, maintenance of feeder to feeder gap, and adjustment of hangers are highlighted. The methods of correction applied for the tilt of pump bowls resulting from severe welding distortion, distribution of load between pump hangers and saddle supports etc., are mentioned. (auth)

11835 (INIS-mf-814) IN SITU MODIFICATION OF E.W.S. TANK. Chopra, K. S.; Johorey, G. C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The emergency water storage tank at the Rajasthan Atomic Power Plant, India, stores 1,800,000 liters of water, which is released within two seconds to cope with the energy release rate from the maximum conceivable accident at 2.2 seconds following rupture. This prevents a rise in building pressure beyond 7.5 psig and hence it is considered as an ultimate in safety. The tank has a diameter of 59′-4″ and height 41′-10″ supported on four columns by a ring girder having web depth of 8′. Extensive cracks were detected by magnetic particle testing at the junction of the tank and supporting ring girder during final inspection. Results of extensive destructive and non-destructive testing dictated replacement of the ring girder. The replacement of the ring girder involved complex problems such as supporting the bottom dish and the top shell separately, assembly of ring girder (which had come from Canada in 16 pieces), and alignment of the same with the bottom dish and top shell to achieve the fit for welding within the specified tolerances. Salient features of the investigation and the procedure involved in the replacement of the ring girder are described. (auth)

11836 (INIS-mf-818) PLANNING AT PROJECT SITE. Kalanidhi, K.; Jambulingam, K.; Subramanian, K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The need for reactor project planning, and in particular construction planning and schedule control is discussed. Successful execution of the project depends on developing good team spirit and compilation of reliable and realistic schedules and implementing them. Based on feed-back information available from the Rajasthan Atomic Power Project, compilation of realistic time estimates for the Kalpakkam reactors at the Madras Atomic Power Project is suggested. It is recommended that the entire site activities be divided into detailed manageable activities, numbering about 10,000, having maximum of one week activity durations. These activities are to be closely monitored and crash actions taken to adhere to schedules. Such a course of action minimizes the stretching of the project schedule. A program implementation system, where working level engineers have a say in planning, decision making, and implementing the day to day activities of the project is suggested. Certain procedures for establishing resource requirements for various activities and how well it can be allocated for optimal utilization are also suggested. (auth)

11837 (INIS-mf-847) CONSTRUCTION EXPERIENCE OF RAJASTHAN ATOMIC POWER PROJECT. Pardiwala, T. F. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 5p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Problems related to construction facilities, housing, staff requirements, etc., in the early stages of the Project are reviewed. Problems faced in having to build the station as per continuously changing design are discussed in detail. Difficulties experienced in correctly estimating cost and time schedule of construction due to late changes in design, delayed deliveries of equipment and materials and sometimes equipment not performing to desired standards are discussed. Organizational problems due to involvement of a large number of agencies in building the station are reviewed. Experience in transportation of heavy and oversized equipment to the Plant Site is brought out. Recommendations to solve the above problems are made at the end. (auth)

11838 (INIS-mf-856) EXPERIENCE ON SURVEILLANCE INSPECTION ON REACTOR COOLANT SYSTEM AT TARAPUR UNITS 1 AND 2. Najundeswaran, K.; Elayaperumal, K.; Venkataraman, L. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 12p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The surveillance program for the reactor coolant systems and the extent of surveillance work done on the two reactors in Tarapur are described. The program consists of two parts, the base line surveillance program in which the primary coolant system in selected critical areas were inspected prior to commissioning and the standard surveillance program in which an attempt was made to inspect the areas during maintenance and refuelling shutdown and compared with the baseline conditions. Defects in certain critical areas found during baseline work were rectified. No gross defects which could probably lead to failure were detected during subsequent work. Because of high radiation and accessibility problems certain areas could not be examined in-service. The importance of making suitable provisions for access to the primary coolant system requiring inspection and the need for development of special inspection tools suitable for use in high radiation areas are brought out. The setting up of a separate regulatory body to follow up complete inspection works in all nuclear plants in India is stressed. (auth)

11839 (INIS-mf-857) PRESSURE AND LEAKAGE RATE TESTING OF RAJASTHAN ATOMIC POWER PROJECT UNIT 1 REACTOR BUILDING. Rustagi, R. S.; Bajaj, S. S.; Krishnan, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The pre-operational pressure and leakage rate tests on the reactor building of Unit-1 of the Rajasthan Atomic Power Project (RAPP) were completed May 14 through May 18, 1971. These tests were entirely DAE responsibility and are the first tests of the kind done in India. Both the absolute and the reference vessel methods were employed for determining the leakage rate. The absolute method was found to be more suitable for Rajasthan Atomic Power Project type containment structures. A brief description of the various tests that were performed, including the preliminary testing program and the test instrumentation is presented. Recommendations that could influence future tests of this kind in India are discussed. (auth)

11840 (INIS-mf-877) OPERATING EXPERIENCE ON TARAPUR INSTRUMENTATION. Joshi, A. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The operating experience with electronic, pneumatic, and electropneumatic instrumentation used in the Tarapur Atomic Power Station is considered. Nuclear instrumentation, radiation instrumentation, and process control instrumentation are briefly described. The various types of failures experienced with each type of instrument are discussed. An attempt is made to indicate different types of failures and their percentage to the total failures on that type for establishing guideline for preventive maintenance planning and training of instrumentation technicians. (INIS)

11841 FUTURE STEPS IN CANADA'S NUCLEAR POWER PROGRAMME. Pon, G. A. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Energy Int.; 9: No. 9, 18-20(Sep 1972).

The future of Canada's nuclear power program is discussed. The role of the CANDU reactors and the BLW reactors in this program is indicated. (ERB)

11842 CIRENE PROJECT REPORT. Broggiato, A. (Ente Nazionale per l'Energia Elecrtrica, Rome); Casagrande, I.; Pedretti, A. Nucl. Eng. Int.; 18: No. 209, 800-802(Oct 1973).

The present state of progress of the Cirene project is discussed. The basic concept is described and the main parameters are given. The position of the project with respect to heavy water reactors is considered. (UK)

11843 ENERGY IN TRANSITION. Cass-Beggs, D. (British Columbia Hydro and Power Authority, Vancouver, B. C.). Eng. J. (Montreal); 56: No. 2, 23-29(Feb 1973).

A general overview of the probable future rate of fossil fuel, hydro, and nuclear power in Canada is presented by the chairman of B.C. Hydro and Power Authority. By the end of this century, total energy demand in Canada is expected to rise to four times, and by 2030 to sixteen times the present demand. Most of the new generating stations required to meet this increased demand will be nuclear powered. Given an additional hydro capacity of 20 to 25 GW, this will mean annual commissioning of 5 GW of additional nuclear capacity by 1981 and of 15 GW per year by 1990. Installation of a nuclear power plant in western Canada is unlikely for at least 10 years because of the large size of nuclear power plants relative to local grid sizes. Canadian plants will probably continue to be heavy-water-moderated, natural-uranium-fueled. (CA)

11844 START-UP OF KANUPP: A CANADA-PAKISTAN TRIUMPH. Mansoor, Z. Sci. Forum; 6: No. 2, 16-17(Apr 1973).

The 137 MW Karachi Nuclear Power Plant (KANUPP) and its significance to Pakistan are described in the brief article, written at a popular level. KANUPP, which now supplies about half of Karachi's electrical power requirements, was built as a result of a 1965 agreement between Canada and Pakistan. Canada provided financial assistance, technical personnel, training and equipment, including the reactor. The reactor uses natural uranium fuel and is heavy-water moderated and cooled. The reactor building is 115 ft in diameter with prestressed concrete walls 4 ft 5 in. thick. Pakistan's fossil fuel reserves are only 800 million tons of coal equivalent, so the Pakistan Atomic Energy Commission is thinking of establishing 10–15 nuclear power plants of 500–700 MW after 1980. Research facilities at Nilore support the nuclear power program. (CH)

11845 BEHAVIOUR OF FISSION PRODUCTS IN THE SGHWR. Clifton, J. J. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 423-426(Oct 1973).

Experience of fission product detection, measurement, and control in the prototype SGHWR at Winfrith Heath during five years of operation is reviewed. Events during this period included initial defects in the feed train clean up plants, resulting in a series of fuel pin failures, and also major modifications to the condenser off-gas systems to meet requirements for operating with fuel defects in the core. The behaviour of the inert gases, iodine isotopes, and other fission products are discussed. (UK)

11846 CANADIAN NUCLEAR POWER DEVELOPMENT. Aikin, A. M. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Eng. J. (Montreal); 56: No. 3, 13-17(Mar 1973).

The market in Canada for nuclear power is developing rapidly and the CANDU system can meet the need. Within a few years, nuclear power will be a major Canadian industry. The CANDU system resulted from a decision to develop a system with the lowest fuel cost which meant natural uranium as fuel, moderated with heavy water. Heavy water coolant and pressure tube construction were to be used. There is a continuing program of support for PHW reactors in addition to interest in alternate cooling systems. Future prospects for the CANDU system are good. The system is flexible and can use alternative fuels. It makes more efficient use of fuel than other thermal reactor systems, and is less affected by rising fuel costs. Costs of CANDU and of American enriched, light water reactors are similar. At this stage, fast reactors are not likely to be needed in Canada. (CA)

11847 GENTILLY-2: BACK TO HEAVY WATER COOLANT. Mod. Power Eng.; 67: No. 5, 57-59(May 1973).

Gentilly-2, a proposed 600 MW(e) nuclear power station using a CANDU-PHW reactor, is described. The design calls for a calandria fitted with 380 horizontal pressure tubes each containing 12 fuel bundles each made from 37 fuel elements containing UO_2 pellets. The heat-transport system consists of two circuits each of two pumps and two boilers. A separate system is provided for reactor shut-down heat. Channel outlet temperature is 312°C, and the steam quality in the outlet header is 4%. Gentilly-2 requires less heavy water per MWe than Pickering. Heavy water management systems are incorporated to minimize loss or downgrading of heavy water from heat-transport and moderator systems. Dual digital computers are used for reactor control, and data from in-core flux detectors backed up by ion chambers are used to change the water level in reactivity-control assemblies. The reactor is shut down by two independent systems: shut-off absorber rods which fall into place by gravity and liquid poison injection. Details of the reactor and turbine buildup, generator, and electrical system are also given, in brief. (CA)

11848 ECONOMIC OPTIMUM OF CYCLIC PARTIAL, LOAD OPERATION OF NUCLEAR POWER PLANTS WITH HEAVY WATER REACTORS. Finnemann, H. Darmstadt, Ger.; Technische Univ. (1972). 107p. (In German).

Thesis.

The question of whether the fuel costs can be lowered by deviating the reactor operating schedule from the system loading is examined using the cyclic part-load operation of D_2O natural uranium reactors. Due to the continuous loading and deloading of D_2O natural uranium reactors, the constant excess reactivity of these reactors is available for flexibility of operation. Following a mathematical formulation of the problem as well as a digression on the theory of optimum processes the optimum part-load operation without and with prompt temperature feed back was investigated. In addition, the optimization criteria for the case of discontinuous loading are given in the appendix. (GE)

11849 DEVELOPMENT OF TURBINE-GENERATORS FOR NUCLEAR POWER. Parsons, N. C. (Parsons (C. A.) and Co. Ltd., Newcastle-upon-Tyne, Eng.). Elec. Rev.; 193: No. 7, 227-229(17 Aug 1973).

The development and design of the 540 MW prototype turbogenerators for the Pickering nuclear station are described. Figures are produced to show the excellent performance during commissioning and operation. Comparisons are made with a contemporary coal fired station which uses steam cycles very similar to those which could be used with current AGR type reactors. (UK)

11850 VIBRATIONS INDUCED BY A TWO-PHASE PARALLEL FLOW TO A ROD BUNDLE: PRELIMINARY EXPERIMENTS ON THE SURFACE TENSION AND GAS DENSITY EFFECT. Dallavalle, F.; Rossini, T.; Vanoli, G. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 6, 333-342(Jun 1973).

It is known that gas density and surface tension are the most significant among the physical properties affecting the thermohydraulic behavior of a two-phase (gas + liquid) flow. Since most experiments in support of nuclear fuel element development are carried out in simulated flow conditions (e.g., air-water flow at atmospheric pressure instead of steam-water flow at high pressure), information on the effect of the above properties on rod bundle vibrations induced by a two-phase parallel flow is particularly needed. Preliminary experiments carried out to this purpose with water-nitrogen and acetone-nitrogen mixtures, at different pressures up to 20 bar, flowing adiabatically along a test section of geometry similar to that of the CIRENE reactor fuel assembly are described. Important qualitative conclusions were drawn from these experiments: both the physical properties considered show a significant influence on vibrations, and vibrations are lower when surface tension is lower and gas density is higher. (auth)

11851 REFINEMENT OF THE CALCULATION METHOD FOR NUCLEAR CONSTANTS OF THE ROVI CELL. Cerullo, N.; Oriolo, F. (Univ., Pisa, Italy). Ing. Nucl.; 13: No. 4, 3-10(1972). (In Italian).

Studies made with the purpose of refining the calculation of a thermal reactor moderated and cooled with organic liquids are reported. The study and analysis of the method of calculation which permits a better evaluation of the hyperfine structure of a highly heterogeneous lattice are first described. After a summary of the development and verification of a particular methodology, it is applied to the calculation of the cell of the ROVI reactor. The results obtained are compared with those made previously for the ROVI reference design. (tr-auth)

11852 CANDU CAN AND DOES. Des. Eng. (Toronto); 19: No. 3, 42-44(Mar 1973).

The success of the CANDU pressurized heavy-water (PHW) power reactor at Pickering is emphasized. Not only are four 750 MW power reactors being built at Bruce, Ontario, but all future reactors built in Canada in the forseeable future will be of the PHW type. The first two 540 MW units at Pickering were financed jointly by Ontario Hydro and by loans from the Ontario and Federal Governments. Pickering 3 and 4, and Bruce Nuclear Power Station, are being financed solely by Ontario Hydro. The calandrias at Pickering are made of stainless steel, 26½ ft. in diameter and 27 ft. long, each containing 390 horizontal fuel channels surrounded by heavy water. Each channel holds 12 fuel bundles with sintered uranium oxide fuel pellets. The heavy water leaves the reactor at 560°F and 1280 psi, then circulates through tube-in-shell heat exchangers. Fuel is changed at power by coordinated refuelling machines at the ends of the reactor. On the average, nine bundles are changed daily in each reactor. Spent fuel is stored under 26 ft. of water. (CA)

11853 CANADA'S NUCLEAR REACTORS. Des. Eng. (Toronto); 19: No. 4, 46-49(Apr 1973).

Canadian nuclear reactors and the evolution of their design are described in this short survey. The early experimental reactors ZEEP, NRX, and NRU are briefly described and changes to reactor design resulting from operating experience with NRX and NRU are indicated. The first Canadian power reactors were the 20 MW(e) NPD and 200 MW(e) Douglas Point reactors. Both used pressure tubes and Douglas Point established the CANDU-PHW design, horizontal tubes, heavy water moderated and cooled. A general description is given of Pickering power station with four 540 MW(e) reactors. The survey describes WR-1 an experimental organic cooled, heavy water moderated reactor and gives advantages of this type of reactor and reasons for the decision not to proceed further with its development in the near future. Gentilly, a 250 MW(e) prototype heavy water moderated light water cooled reactor, is mentioned. (CA)

11854 EXPLOSIVE PLUGGING FOR SEALING TUBE LEAKS. Nucl. Can.; 13: No. 4, 3(May 1973).

An explosive welding device for sealing steam-generator tube leaks is briefly described. A hollow, Monel plug containing an explosive charge is placed in the leaky tube where it joins the tube sheet, and detonated to permanently seal the tube. The plug described was designed for use at the Pickering Nuclear Generating Station. (CA)

11855 EMERGENCY CORE COOLING AND THE CANDU SYSTEM. Law, C. Nucl. Can.; 12: No. 2, 1-2(Feb 1973).

The safety of the CANDU Canadian nuclear power reactors is discussed. Independent of the reactor control system, each reactor has an emergency shutdown system, an emergency cooling system, and a containment system. The worst possible type of accident is considered to be simultaneous failure of any two of these systems: the simultaneous failure of all three is considered to be so improbable as to be virtually impossible. Even if the emergency shutdown and emergency cooling systems failed, the moderator spray would provide enough cooling to prevent the

fuel from melting, and fission products would be contained within the containment system. In a postulated blow-down accident, in which the main coolant header (1.5 in. steel) failed, the maximum temperature attainable by zirconium-alloy cladding, in the few seconds before emergency cooling became operative, would be 800° to 1000°C. It is stated that no explosive chemical reaction, such as a hydrogen explosion, is possible. (CA)

11856 HOW THEY USE THE COMPUTER SYSTEM FOR ALARM RESOLUTION AT THE GENTILLY STATION. Craik, N. G. (Canatom Ltd., Montreal). Can. Contr. Instrum.; 11: No. 12, 24-29(Dec 1972).

A brief description of computer controlled alarm systems at the Gentilly nuclear generating station is presented. Optimization of the system, which consists of dual computer control of alarm annunciation, is discussed. To ensure control in the event that one computer fails, it is reported that both units operate in parallel at all times. Problems associated with over dependence on computer systems and their resolution are also established. (CA)

Power Reactors, Breeding

Refer also to abstracts 10289, 11762, 11996–12005, 12007, 12008, 12012, 12024–12026, and 12190.

11857 (ANL-8047) HYDROGEN-METER LEAK DETECTOR FOR LMFBR STEAM GENERATORS. Vissers, D. R.; Holmes, J. T.; McPheeters, C. C.; Kolba, V. M.; Bartholme, L. G.; Nelson, P. A.; Burris, L. (Argonne National Lab., Ill. (USA)). Oct 1973. Contract W-31-109-eng-38. 47p. AT.

A monitoring system has been developed for detecting leaks in LMFBR steam generators by the detection of the hydrogen produced in the sodium-water reaction. The principal capabilities of this detection system are rapid response, high sensitivity, and high stability and reliability. The monitoring system is based on the detection of a change in hydrogen concentration in sodium by measurement of the change in the rate of hydrogen diffusion through a nickel membrane by an ion pump, and the partial pressure of hydrogen on the vacuum side, a measure of the hydrogen flux and the hydrogen activity in the sodium, is determined by the measurement of the current to the ion pump. This level of sensitivity and stability are adequate to detect a water leak as small as 10^{-4} lb/sec at a sodium flow rate of 10^7 lb/hr in <1 min, if the hydrogen concentration in the secondary sodium is ~0.1 ppM. Leak detector modules have been designed, built, and installed on the Sodium Components Test Installation (SCTI) at the Liquid Metal Engineering Center (LMEC). Preliminary studies with the operation of these modules on SCTI show they operate in a reliable and stable manner. (auth)

11858 (ANL-RDP-20) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1973. (Argonne National Lab., Ill. (USA)). 23 Oct 1973. Contract W-31-109-eng-38. 156p. Dep. NTIS $7.60.

Porgress in LMFBR development studies is reported under the following headings: EBR-2; hot fuel examination facility; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and environmental studies. (JWR)

11859 (BNWL-tr-95(Pt.2)) PRODUCTION OF FIRST RAPSODIE CORE. Part II. Results of Production. Masselot, Y.; Bataller, S.; Ganivet, M.; Guilliet, H.; Robillard, A.; Stosskopf, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). Jun 1970. Translation of CEA-R-3501(2). 67p. Dep. NTIS $5.50.

The fuel characteristics for Rapsodie are described and a synthesis of the main results is presented. The synthesis incorporates the parameters of greatest interest to the manufacturer in the form of a histogram for comparison with the specifications. It can be used to evaluate the manufacture qualitatively and to bring out points which need improvement. Results are also presented in the form of tables and in a way which seems appropriate for users of the reactor itself or which facilitates an investigation of the fuel following irradiation. (auth)

11860 (BNWL-tr-95(Pt.3)) MANUFACTURE OF THE FIRST RAPSODIE CORE. Third Part. Special Technical Problems. Masselot, Y.; Bataller, S.; Ganivet, M.; Guilliet, H.; Robillard, A.; Stosskopf, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). Mar 1973. Translation of CEA-R-3501(3). 30p. Dep. NTIS $3.50.

Divergencies noted in fabrication of the first Rapsodie core are discussed. Information is included on Pu content in the fuel, O/M ratio, and properties of second phases in the fuel. (JRD)

11861 (CEA-R-4495) APPLICATION OF GAS PHASE RADIOCHROMATOGRAPHY TO THE ANALYSIS OF FISSION GASES OF A FAST REACTOR. Massimino, D. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Dec 1973. 54p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

The effects of fission product transfer phenomena occurring across the fuel, cladding, and sodium in the case of a burst slug in the fast reactor RAPSODIE are little known. The duration of these phenomena is a priori unknown thus necessitating the use of a rapid analysis method. A procedure using a chromatographic column in conjunction with a γ-ray detector enabled different models to be envisaged for the bursting from studies of the fission gases. It is envisaged that these measurements will lead to the recognition of the importance of each transfer. An attempt was made to optimize this procedure whose analysis cycle is 10 minutes. The optimum conditions for chromatographic separation (substrate, length and diameter of column, temperature, gas flow vector, stability, volume injected, and impurities, and detection (crystal, detection volume, material used, triggering of scalars) were determined. The application to a prototype placed on the argon covering of the reactor demonstrated the possibilities of exploiting the procedure and also its industrial character. (auth)

11862 (CONF-730942-(P2), pp vp Sect. E1/8) DESIGN OF PRIMARY CONTAINMENT FOR LOOP AND POOL ARRANGEMENTS OF LMFBRs. Huebel, H. (INTERATOM, Bensberg, Ger.); Koehler, M.; Lange, L.; Cobb, E. C.; Leigh, K. M. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

LMFBR-prototypes have different technical concepts for the primary system: France and the U. K. are constructing pool-type reactors, USA and DEBENELUX have selected loop-type reactors. Obviously the relation between the technical concept and the possibilities to limit the consequences of a hypothetical whole core accident is a widely discussed question. Pressure loading and response of radial and axial structures are discussed. Three modes of loading phenomena are considered: the transient pressures due to expansion of the vaporized fuel; the transient pressures given by a coherent sodium fuel interaction; and the "equilibrium" pressure given by transferring the excess heat in the fuel to an amount of sodium which produces the highest possible quasi steady-state pressure in the system. The axial forces during the accident have to be transferred via the plug and via the core support to the reactor vessel support. The technical solutions depend on the primary system concept. The given structures can be supplemented by special devices to protect cover and vessel against excessive loads. In a first approximation, such safeguards are independent of the technical concept. The post accident heat removal is accomplished for commercial plants preferably by in-vessel solutions. The expenditure for in-vessel solutions depends more on singularities of a given design than on the particular design concept. The intermediate (primary/secondary sodium) heat exchanger is a critical component of the containment system. The coupling between the source of the accident and the intermediate heat exchanger is different in both systems. Pool and loop systems are both adequate in limiting the consequences of an unprevented nuclear excursion of a reasonable size. Advantages and disadvantages are well-balanced for both systems. (auth)

11863 (CONF-730942-(P2), pp vp Sect. E2/3) SUSPENDED STEEL PRIMARY SODIUM TANK FOR A COMMERCIAL FAST REACTOR IN A STRONG CONTAINMENT. Wolff, P. H. W. (British Nuclear Design and Construction Ltd., Whetstone, Eng.); Beckett, V.; Prescott, R. F.; Dener, Y. M. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the safety case for commercial fast reactors (CFR), it is evident that containment can play an important part in providing protection against accidents that have a finite probability of leading to energy release from the core. In the case of reactors having integral primary plants contained in a tank, it is attractive to consider strengthening the concrete shielding in the roof and side walls by prestressing in order to provide the containment. The concrete containment walls must be kept at a suitably low temperature and protected by thermal barriers against the contained sodium at a temperature of about 400°C. Suspending a steel membrane tank within a strong vault from its roof, so that the main thermal insulation consists of an inert-gas filled gap between tank and vault liner, appears to be a possible proposition. The results of some typical stress explorations in the upper regions of the tank are presented. The importance of the temperature gradient in the tank wall at the junction is illustrated: important reduction of bending stress at the junction can be achieved by local suppression of gradient. Further reduction can be achieved by local tapering of the tank wall thickness. Further substantial reduction can be achieved by introducing a horizontal "flexing plate" a short

distance below the junction, the vessel load (i.e., mainly the weight of the contained sodium) being carried by flexible links. This device has the effect of making the stresses at the junction almost invariant with sodium temperature; the temperature variable stresses below the junction are relatively small. The stress results obtained are briefly assessed in relation to the available design codes. (auth)

11864 (CONF-730942-(P2), pp vp Sect. E5/3) VELOCITY INFLUENCE ON THE FREE VIBRATIONS IN A COUPLED SYSTEM FLUID-STRUCTURE. Cesari, F.; Curioni, S. (Univ., Bologna). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The PEC reactor (a sodium-cooled fast reactor) has in the core central zone a cavity within which some test loops are inserted to carry out experiments on fuel elements. These loops are fuelled by an independent circuit from the reactor primary circuit so that the experimental fuel element may be subjected to particular load conditions. The realization of these loops raises remarkable problems for the reactor safety, and both the static and dynamic response of these structures must be carefully evaluated. In the present stage of design two different solutions exist: the first foresees the construction of a U test loop in which the inlet and the outlet pipe of the coolant are uncoupled, while a second solution foresees a more compact system constituted by two coaxial tubes. In this second case, the coolant flows down in the interspace between the pipes and flows up again in the internal one, this determining an influence of both velocities on the system dynamic response. The present work has the aim to study the dynamic behavior of the latter solution, determining the natural frequencies of the coupled fluid-structure system as function of the two fluid velocities (in the internal tubes and in the interface). After defining the problem by writing the system of motion differential equations relatively to the internal and external fluid, the pressure acting on the two tubes is derived from the velocity potential assuming an irrotational flux and imposing the conditions to the outline. The calculation of the natural vibration frequency is made by means of the model analysis. The natural frequencies have been obtained by solving a polynomial of 2n degrees corresponding to n in-phase frequencies and n out-of-phase frequencies. (auth)

11865 (CONF-730942-(P2), pp vp Sect. F1/5) MECHANICAL DESIGN AND ANALYSIS OF THE "SNR-300" CORE RESTRAINT SYSTEM. Hosemann, B.; Madell, J. T. (INTERATOM, Bensberg, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The SNR-300 core restraint system is a passive one, consisting of two ferritic-steel rings, one above the core plane and the other below. Differential thermal expansion between the core structure and rings results in sufficient clearances for refueling, but an almost tight arrangement in the below-core plane during operation. A 6-10 mm clearance in the upper plane maintains the designated alignments. The across-flat dimension of special reflector elements at the load planes can be changed to accommodate uncertainties in the mechanical design. The elements, deflected due to differential thermal expansion and steel swelling, interact with their neighbours. The design of the restraint system strongly influences the arrangement of the elements and in turn, the bowing reactivity effects and the forces and stresses in the wrapper tube. The analysis considers several geometrical and mechanical representations of element interaction, as well as a range of swelling and creeping values within the confidence limits of the correlations for these effects. Although large uncertainties still exist in the design data and methods for the core restraint system, the predicted performance of the SNR system is satisfactory over the expected range of these effects and beyond. 4 references. (auth)

11866 (CONF-730942-(P2), pp vp Sect. F3/8) COMPUTER CODE DEVELOPMENT AND TEST OF STRUCTURAL ANALYSIS FOR DOUBLE WALL PIPING OF FBR PRIMARY COOLANT SYSTEMS. Kawaguchi, O. (Power Reactor and Nuclear Development Corp., Tokyo); Iwase, T.; Fujita, K. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Double wall piping structures are to be adopted for the main and auxiliary primary coolant systems of the Japanese Fast Breeder Reactor "MONJU". The double wall piping structures consist of inner piping and outer piping. Through the inner piping flows the sodium coolant and through the annulus between them passages preheating gas. In case of sodium leakage through small cracks on the inner piping, the outer piping must act as a containment structure. Since there were few data available on mechanical and structural behaviors for double wall piping design, attention has been concentrated on two objects: to study experimentally mechanical and structural behaviors on double wall piping; and to develop a computer code for static analysis, and vibration, and earthquake response analysis of the structures. The models of double wall piping with the pad-connections, the welded flange connections and bellow structures were erected. The inner piping should have the mechanisms so as not to be constrained by the outer one, and the difference of expansion and contraction between them can be absorbed by bellow structures. These models break down into four kinds; the straight model, the curved model, the bellow model and the simulated loop model. A computer code for numerical solutions on these experimental models was developed. In this computer code the modified Choleski decomposition method, the power method and other useful methods were employed. The computed results on the vibration and static analysis for the experimental models have shown good agreements with the experimental results. (auth)

11867 (CONF-730942-(P2), pp vp Sect. F4/5) THERMAL LOADING TEST OF NUCLEAR REACTOR NOZZLE MODEL USING SODIUM LOOP. Miyazano, S. (Japan Atomic Energy Research Inst., Tokai); Kodaira, T.; Atsumo, H.; Ito, K. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

It is generally known that thermal shock occurs at the inner surface of the inlet and outlet nozzles of a fast breeder reactor by sodium when the reactor is started and stopped in usual operation or by any accidents. It is however, very difficult that the exact transient stress or strain by thermal shock can be obtained quantitatively at the area, experimentally and also theoretically. Several tests were tried using a sodium testing loop to obtain experimentally the values of thermal strain and to compare the results with the theoretical values. Many chromelalumel thermo-couples were attached to stainless steel nozzle model, in which the shell and pipe thickness was 15 and 3 mm, respectively, to measure the temperature distributions on the inner and outer surface and radial direction and some high temperature strain gages (Microdot type) were welded on the outer surface to measure the thermal strain before the model was set in the sodium loop. It is shown that the maximum thermal strain was nearly equal to the yield point of stainless steel, although it seems that these testing conditions were severe. (auth)

11868 (CONF-730942-(P2), pp vp Sect. F4/7) FATIGUE CRACK GROWTH IN AUSTENITIC STAINLESS STEEL STRUCTURES. Henry, B.; Bernard, J.; Gieb, P. (EURATOM, Ispra, Italy). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Fatigue crack propagation is one of the possible failure processes of the coolant containment structures of type LMFBR (vessel and tubing). This phenomenon is being studied from the point of view of both the general material behavior and the method of prediction from the latter, of the structure behavior taking into account the actual geometry and loading parameters. 6 references. (auth)

11869 (CONF-730942-(P2), pp vp Sect. F4/8) FRACTURE BEHAVIOR OF FERRITIC AND AUSTENITIC STEEL PIPES. Zeibig, H.; Fortmann, F. (INTERATOM, Bensberg, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Recent developments are described in the analysis of ferritic and austenitic structural materials provided for use in the design of the liquid metal fast breeder reactors KNK II and SNR. To prove the integrity of the primary systems, a fracture mechanics approach is used to define the critical crack-tip stress conditions for rapid failure and fatigue crack propagation. The experiments were conducted with through-wall flawed specimens of the original pipes used in the loop of the KNK-reactor and with specimens of the same wall thickness as provided for use in SNR. The experimental results are compared with new calculations based on fracture mechanics. They are in good agreement with the theoretical predictions for critical flaw sizes and fatigue crack propagation rates. The results of fatigue crack propagation drawn from measurements on austenitic specimens are in agreement with experimental results of other investigations with flat plates. The investigations do not show any indications that unstable fracture would be possible under operational conditions, both the ferritic and the austenitic steel used in the design of KNK II and SNR. Compared with the wall thickness, the critical crack lengths are so large that failures will manifest themselves by leaking prior to fracture. 6 references. (auth)

11870 (CONF-730942-(P2), pp vp Sect. F6/3) THERMAL STRESSES IN FAST REACTOR BOILER TUBES AT THE SODIUM/GAS INTERFACE. Wright, M. B. (Berkeley Nuclear Labs., Eng.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In most fast reactor boiler designs the water/steam passes through the boiler tubes receiving heat from the secondary sodium. The tubes may be terminated in a tube plate or passed through a perforated head and then terminated in a header. In both of these desigas a small gas space is usually included above the sodium. This gas space provides some protection for the tube plate of performed head from thermal transients in the sodium. The thermal stresses in a tube at the sodium/gas interface are analyzed. These stresses are a function of the physical properties of the tube, the temperature of the water/steam and the sodium, and the heat transfer coefficients of the sodium, water/steam and gas (h_{sodium}, h_{steam}, h_{gas}). In the analyses it is assumed that $h_{sodium} > h_{steam} \gg h_{gas}$. The steady state temperature distributions in various tubes were evaluated using the finite element program FLHE. The corresponding stresses were then evaluated using the finite element program BERSAFE. The effects of both gradual and sudden rises in the level of the sodium were investigated, such rises being possible during changes in load. It was concluded that a good estimate of the transient temperature and stress distribution within a tube could be obtained if the corresponding steady state distributions were assumed to have a move with the level of the sodium. This result was used to examine the effect that a rise in the sodium level had on the oxide layer within the boiler tube. 6 references. (auth)

11871 (CONF-730932-(P2), pp vp 1p.) THREE-DIMENSIONAL DEFORMATION AND REACTIVITY CHANGES OF A LMFBR-CORE. Hoang, Y. S. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

11872 (CONF-730942-(P2), pp vp 1p.) "CONCOR": A NUMERICAL CODE TO PREDICT THE CONFIGURATION OF A LMFBR CORE TAKING INTO ACCOUNT SUBASSEMBLIES INTERACTION, SWELLING, THERMAL BOWING, AND CREEP. Pederzini, A.; Russo, S.; Viotti, V. (Progettazioni Meccaniche Nucleari, Genoa). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

11873 (CONF-730942-P2), pp vp 1p.) MECHANICAL VIBRATION ANALYSIS OF AN INTEGRATED INTERMEDIUM HEAT EXCHANGER AND CIRCULATING PUMP FOR LMFBR STATIONS. Ferrari, L.; Moschella, U. (Progettazioni Meccaniche Nucleari, Genoa). 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

11874 (GEAP-10028-47) SODIUM-COOLED REACTORS CORE ENGINEERING PROGRAM. Forty-seventh Quarterly Report. May–July 1973. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Aug 1973. Contract AT(04-3)-893. 98p. AT.

Progress is described for tasks related to fuel rods, fuel rod assemblies, core restraint, control and blanket assemblies, and defected fuel. (auth)

11875 (INIS-mf-883) DRIVE SYSTEM OF CENTRIFUGAL SODIUM PUMPS. Hunjan, A. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

The important features on which the drive system of the sodium pump in the Fast Breeder Test Reactor (FBTR) at Kalpakkam is based are described. They include large inertia emergency drive, fast acceleration and deceleration, speed control and capability to smoothen the undesirable transients in sodium system. The process and equipment safety requirements that led to the selection of Ward Leonard system for driving of these pumps are explained. The salient features of the Ward Leonard system, as they will exist in FBTR, are also discussed. (INIS)

11876 (ORNL-4901) FAST BREEDER REACTOR OXIDE FUELS DEVELOPMENT: FINAL REPORT. Lotts, A. L. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 188p. AT.

Preparation, fabrication, irradiation, and evaluation of fast breeder oxide fuels are reported for a five-year development program. Emphasis is on irradiation testing of sol-gel uranium-plutonium, particularly fabricated by the Sphere-Pac loading of coarse and fine microspheres into the cladding. The scope of the program is outlined. A summary, conclusions, and recommendations are included. Publications and other documents of the program are listed. (auth)

11877 (RCN-195) INVESTIGATION ON TEMPERATURE NOISE IN LIQUID SODIUM FLOWING THROUGH AN ELECTRICALLY HEATED 4-PIN BUNDLE. Mika, C.; Raes, K. H.; Tuerkcan, E.; de Vries, J. E. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Jun 1973. 56p. Dep. NTIS (U. S. Sales Only) $5.00.

The experiments of temperature noise measurements in a sodium cooled electrically heated four-pin bundle are described. The experiments are made with three different sodium flow velocities (2, 4 and 6 m/s) and three different heat fluxes (75, 250 and 350 W/cm^2). The fluctuating signals of three thermocouples located in the same stream line in the central subchannel were the object for the analysis (on-line and off-line) in time and frequency domain. The measured transit time of the coolant flow, the effect of the heat exchange between wall and coolant on the measured transit time, and the measured RMS value of temperature fluctuations vs flow rate and heat flux are given. With a simple model the possible error on the coolant transit time measurements is verified. It is shown to be possible to estimate a mean heat transfer coefficient from the shape of the transfer function between two thermocouples, using the same simple model. Experimental values are in reasonable agreement with measured local heat transfer coefficients. (21 references) (auth)

11878 (RCN-197) POST-IRRADIATION EXAMINATION OF FAST REACTOR FUEL PINS IRRADIATED IN A SODIUM ENVIRONMENT UP TO ABOUT 55 MWd/kg UO_2. Kwast, H. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Nov 1973. 103p. Dep. NTIS (U. S. Sales Only) $7.25.

Two fast reactor fuel pins have been irradiated in a sodium environment in the HFR Poolside Facility at Petten to a burnup of 41.8 and 53.8 MWd/kg UO_2, respectively. The fuel pins consisted of 50% enriched UO_2 pellets of 5.1-mm diameter, canned in an X-8 Cr Ni MoV Nb 16.13 (Werkstoffnr, 4988) stainless steel tube with an outer diameter of 6.0 mm and a wall thickness of 0.38 mm. Both irradiations had to be terminated prematurely; the first one (R62-A03) because of a breakdown of the midplane thermocouples and the second one (R62-A04) because of fuel pin failure. The target burnups were 50 and 80 MWd/kg UO_2, respectively. The maximum measured sodium temperature was 650°C, which means that the maximum average canning has been 750°C. The average heat ratings in the fuel pins were about 600 W/cm. About 70% of the fission gases formed in fuel pin A03 have been released. The canning on the failure spot in A04 showed an axial crack with a length of about 25 mm and a maximum width of about 2 mm. Part of the fuel at the location of the failure was washed out and was found at the bottom of the capsule between the shroud tube and sodium containment. Dimensional control after irradiation revealed that the maximum change in diameter of fuel pin A03 was 1.2%. For A04 this was about 3.3%. Considerable interaction between fuel and canning was observed in both fuel pins. (71 figures, 11 tables) (auth)

11879 (RDT-C-12-1-T(11-73)) GAS CHROMATOGRAPH SYSTEM FOR SODIUM COVER GAS SERVICE. (USAEC Division of Reactor Research and Development, Washington, D. C.). Nov 1973. 16p. RSO.

The requirements are presented for the application engineering, materials, quality assurance, fabrication, examination, acceptance testing and delivery of a gas chromatograph system (including analyzer section and control and readout section) for the continuous on-line measurement of trace impurities in the inert gas used as a cover for liquid sodium. The cover gas sample delivered to the gas chromatograph system shall not exceed 1 ppm of sodium vapor. (auth)

11880 (WARD-SS-3045-4) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS. Quarterly Progress Report for Period Ending October 31, 1973. Gibson, G.; Wrights, G. N.; Rittenberger, R. V. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1973. Contract AT(11-1)-3045. 15p. AT.

A "rod-drop" experiment was planned to determine if the time behavior of the count rate of an ex-vessel LLFM would be the same as an in-vessel LLFM following the rapid shutdown of the reactor. Preliminary results from this experiment could not be interpreted. Additional experiments will be performed during the next quarter. Joint planning by RRD, ORNL, and ARD will be required. The experiments were completed to determine the enhancement of the LLFM count rate due to surrounding the detector with graphite and the first generation fissions in the stored fuel as a function of the stored fuel location. (auth)

11881 THERMAL INSULATION FOR THE SURFACE OF A CONTAINER FOR A LIQUID METAL COOLED NUCLEAR REACTOR. Hind, J. R. (to United Kingdom Atomic Energy Authority). US Patent 3,764,468. 9 Oct 1973. Priority Date 20 Feb 1969, United Kingdom of Great Britain and Northern Ireland. 4p.

A thermal insulation assembly for the inside surface of a container for a liquid metal cooled nuclear reactor is described which comprises a multiplicity of gas filled and sealed cylindrical

containers mounted side by side with their longitudinal axes normal to the surface, the spaces between the cylindrical containers being occupied by gas filled and sealed prismatic containers conforming in shape to the spaces between the cylindrical containers, the surfaces of the cylindrical containers being spaced by a small amount from the corresponding surfaces of the prismatic containers. (Official Gazette)

11882 PROCESS FOR FABRICATION OF FUEL ELEMENTS FOR NUCLEAR REACTORS. Richter, K.; Gabolde, J.; Bouillet, J. M. (to EURATOM). German Patent 1,943,431. 25 Feb 1971. Filed date 22 Aug 1969. (In German).

A process for fabrication of fuel elements for fast breeder nuclear reactors is described. The core in the form of pellets or rods is placed into the jacket, then the fissile material in the form of particles between the core and the jacket by vibrations. The maximum diameter of the limiting zone is essentially equal to the distance between the core and desired jacket. (TSS)

11883 DEVELOPMENT PROBLEMS OF NUCLEAR POWER PLANTS WITH GAS-COOLED FAST BREEDERS AND GAS TURBINE IN DIRECT CIRCUIT. Schilg, G. (Technical Univ., Dresden); Soergel, G.; Wagner, B.; Cordes, G.; Doege, R. Kernenergie; 16: No. 3, 78-87(Mar 1973). (In German).

Some results of investigations on nuclear power plants with gas-cooled fast breeder and direct-loop helium turbine are reported. Starting from an integrated construction type of power plants some essential problems of the reactor, turbo-machine, heat exchanger, and heat removal at the cold end of power plant cycle are discussed. With that, emphasis was on the so-called "conventional" part of the power plant. For the reactor, in the main some data were taken from literature in order to draw a conclusion for the design of the conventional part and its interaction with the reactor. Finally, results of comparative economical considerations of different nuclear power plants with the fast breeder reactor are given. (auth)

11884 STATE REPORT ON THE FAST BREEDER PROJECT 1973 IN BENSBERG. Hueper, R. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 40-41(1973). (In German).

The contents of the summarizing lectures are briefly given dealing mainly with the state of work for the SNR 300. In addition, a survey on fission and fusion problems is given. In the rostrum discussion, the next steps in the development of fast breeder constructions are discussed. (GE)

11885 IRRADIATION TESTING IN THE DEVELOPMENT OF GAS-COOLED FAST BREEDER REACTOR FUEL ELEMENTS. Lindgren, J. R. (Gulf General Atomic, Inc., San Diego, CA); Campana, R. J.; Langer, S.; Weinberg, A. F.; Simon, R. H.; Longest, A. W.; Strain, R. J. Brit. Nucl. Energy Soc.; 12: No. 4, 395-408(Oct 1973).

The irradiation program for the development of fuel elements for the gas-cooled fast breeder reactor GCFR is discussed. Thermal flux irradiations included two vented mixed-oxide fuel rods, one irradiated to 54,000 MWd/Te and one that attained a burn-up of 20,500 MWd/Te. These experiments provided design data and confirmed the feasibility of the vented fuel concept. Fast flux irradiation of an assembly of seven encapsulated mixed-oxide sealed fuel rods to planned burnups up to a maximum of 100,000 MWd/Te in progress. Interim examinations at 25,000 and 52,000 MWd/Te showed that all rods remained intact even at the maximum cladding outside surface temperature of 780°C (1436°F). A second capsule assembly will be irradiated in a fast flux starting early in 1974. (auth)

11886 OPTIMIZATION OF THE CHARACTERISTICS OF A FAST NEUTRON POWER PLANT. Chaumont, J. M.; Ravier, J. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 182, 7-11(Jun 1973). (In French).

A brief description is given of an optimization method which allows the designer to select the characteristics of a liquid metal fast breeder reactor with the least energy cost criterium. (Fr)

11887 DEVELOPMENT TENDENCIES OF THE SODIUM FAST BREEDER. Traube, K. (INTERATOM, Bensberg/Cologne, Ger.). Atomwirt., Atomtech.; 18: No. 10, 461-465 (1973). (In German).

From reactor meeting; Karlsruhe, Ger. (10 Apr 1973).

Since the beginning of the fifties twelve experimental sodium breeders have been built, of which eight have already provided some years of operating experience while the remaining four are still not in operation. Since the end of the sixties, this phase of experimental reactors has overlapped the construction of prototype power stations with capacities of around 300 MWe. In Western Europe the phase of demonstration power stations is now being planned and this is regarded as a transition to the commercial utilization of the sodium fast breeder. The fast breeder demonstration power stations Superphenix (France), CFR (Great Britain), and SNR-2 (FRG) are at present being planned in an international collaboration of the electricity industry. The pre-planning of these demonstration stations is in each case now taking place at national levels by the manufacturing industries and research centers, but there are strong tendencies toward the creation of international groups. The German-Belgian-Dutch collaboration in the SNR-300 is a first start in this direction which will also be continued for the SNR-2. The pre-planning work for the SNR-2 began in the middle of 1972 by the German firm INTERATOM. A capacity of up to 2,000 MWe has been taken as a basis for the preliminary plan. (GE)

11888 BEHAVIOR OF RADIOACTIVE IMPURITIES IN DFR LIQUID METAL COOLANT. Davies, R. A.; Drummond, J. (United Kingdom Atomic Energy Authority, Dounreay, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 427-435(Oct 1973).

The use of a vented U–Mo alloy as the driver fuel in DFR has resulted in contamination of the Na/K coolant by fission products and fissile material. Over several years information on the longer lived fission products and other radioactive contaminants associated with components of the primary coolant circuits has been obtained from the following sources: Na–K alloy samples from the primary circuit, cold trap deposit, corrosion meter speciment holders and other metal specimens, pipe sections removed during repair operations, and stainless steel mesh filters in the reactor core. Methods of sampling and analysis are described. The results are discussed and several conclusions are drawn as to the behaviour and distribution of fission products in DFR. (UK)

11889 GAS-COOLED FAST BREEDER REACTOR STUDIES. Dee, J. B.; Fortescue, P.; Larrimore, J. A. (Gulf General Atomic, Inc., San Diego, CA). J. Brit. Nucl. Energy Soc.; 12: No. 4, 387-394(Oct 1973).

Recent design and assessment work performed on gas-cooled fast breeder reactors by Gulf General Atomic is outlined. A description is given of the 300 MW(e) gas-cooled fast breeder reactor demonstration plant design, and safety aspects of the plant are discussed, including potential flow blockage and coolant depressurization accidents. In addition preliminary studies of larger GCFR plants which show great flexibility of design and good performance are discussed. (auth)

11890 NUCLEAR FUEL ASSEMBLY. Ripley, C. C. (to General Electric Co.). US Patent 3,764,471. 9 Oct 1973. Filed date 1 Jun 1970. 6p.

A fuel assembly containing nuclear fuel rods in spaced array comprising a tubular coolant flow channel and fuel rod spacer assemblies formed of cross-laced beams supported directly by the flow channel is described. (Official Gazette)

11891 FABRICATION OF FUEL ELEMENTS FOR THE PEC REACTOR. Dalmastri, B.; Dusi, G. B.; Fizzotti, C.; Foli, U.; Menci, F.; Traversi, G. (CNEN, Cassaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 7, 21-18(Jul 1973). (In Italian).

In the last few years the CNEN's Materials Technologies Laboratory has studied and developed the techniques for the fabrication of fuel elements for the PEC reactor. This activity, which has resulted in the fabrication of a certain number of such elements, was not limited to gaining fabrication experience, but was also intended to transfer knowledge from the design to the blueprint stage. In effect, the PEC fuel element comprises certain components of rather intricate design, whose fabrication by conventional methods is extremely complex and sometimes impossible. In other cases operational techniques had to be developed, such as the winding of the spacer wire over the rods, which have required the design of specific equipment and tooling. In both cases, original fabrication techniques were studied, which have produced highly satisfactory results. The aim of the activity was not so much the fabrication of elements as the study of fabrication methods and the optimizing of operational parameters. (auth)

11892 CRITICALITY STUDIES OF MULTIZONE FAST BREEDER REACTORS IN THE $^{238}U-^{239}PU$ COUPLE. Pavelescu, M.; Adam, S.; Purica, I. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 6, 757-766(1973).

Criticality studies of fast breeder reactors of spherical geometry within the two-group diffusion approximation are reported. Each reactor is supposed to consist of several homogeneous concentric zones of different compositions. The two-group neutron flux equations are rigorously solved for an arbitrary zone, and a criterion is given for the determination of the character of the zone. Further, a solution which can be evaluated numerically is obtained for the neutron flux spectrum over the entire reactor range. This solution is normalized to the maximum reactor power density. Numerical

results are reported for two- and three-zone fast reactors corresponding to several fissile material and fertile material strategies. Calculations have been made for 118 reactors of small dimensions, each reactor containing a same given amount of fertile material, for which the diffusion approximation is known to be valid. The obtained results show that three-zone reactors are more advantageous than the usual two-zone reactors, from the point of view of the breeding properties. (auth)

11893 METHOD OF CORRELATED TEMPERATURES FOR DETERMINING THE HOT CHANNEL FACTOR IN A LIQUID METAL FAST BREEDER REACTOR. Chu, B. B.; Mazumdar, M. (Westinghouse Research Labs., Pittsburgh). Nucl. Sci. Eng.; 52: No. 3, 396-398(Nov 1973).

The method of correlated temperatures provided a technique for computing the hot channel factor when a maximum fixed, but nonzero, number of hot channels is permitted in a reactor core. This method made adequate allowance for the fact that, of the various identifiable uncertainties affecting the core, some are global and some are local in nature. A method is provided which has the same objectives as those of the method of correlated temperatures and uses the same formulation, but does away with the Monte Carlo computations of the latter. It is believed that the analytical method provided can be more easily adapted to the computations of hot channel reliability in an actual reactor. (auth)

11894 STATUS REPORT ON THE FAST BREEDER PROJECT 1973. Commencement of Construction of Prototype. Hueper, R. (Kernforschungszentrum, Karlsruhe, Ger.). At. Strom; 19: No. 7-8, 73-75(1973). (In German).

The supply contracts for the prototype SNR 300 of a sodium-cooled fast breeder nuclear power station came into force on 19th March 1973. This was announced at the beginning of this year's status report on the fast breeder reactor project on 20th March, 1973. In the meantime, in April this year, excavation work commenced near Kalkar (Lower Rhine) where the plant is to be built. (GE)

11895 PROCESS FOR HANDLING NUCLEAR REACTOR FUEL ELEMENTS. Schachtele, R.; Thevenot, L. (to Commissariat a l'Energie Atomique). French Patent 2,139,707. 1 Jun 1971. 9p. (In French).

A process for handling nuclear reactor fuel elements (particularly intended for fast sodium cooled nuclear reactors) is presented. The following type of reactor is considered: a reactor in which access to the core is gained through a single small diameter orifice positioned eccentrically in a first plug which is free to rotate about its axis; this first plug is itself fitted eccentrically into a second rotating plug. The combined but independent rotation of the system formed by the two plugs enables the orifice of the first plug to be vertically aligned with a group of elements in the core. The process proposed permits the charging and discharging of new and spent fuel elements, two separate machines working simultaneously, but in parallel, being used for the purpose. The new fuel elements are transferred from a storage place to the orifice giving access to the core through the rotating plug system. The spent fuel elements are transferred from the reactor core across this same orifice and into a well used for the recovery a spent fuel. (FR)

11896 INSTALLATION FOR SUPPORTING A REACTOR VESSEL. Sauvage, M. (to Commissariat a l'Energie Atomique). French Patent 2,150,627. 2 Sep 1971. 7p. (In French).

The following type of reactor is considered: a liquid metal cooled core reactor consisting of a principal vessel containing the core, the liquid metal coolant, and the components ensuring the circulation of the liquid metal. The primary vessel of the reactor encloses the core and determines the paths taken by the coolant across the core and the components. A roof traversed by the components covers the principal vessel to which it is connected. A protective slab is positioned above the principal vessel and is provided with a rotating plug having a hole situated over the top of the core and other access holes situated over each of the components. A skirting is provided over at least part of the components traversing the roof, this skirting extending the roof over the slab. Means for support are provided between the skirting and the slab at the upper part of each skirting such that the principal vessel is suspended from the slab by these skirtings. (FR)

11897 INTEGRATED EXCHANGER NUCLEAR REACTORS. Crambes, M.; Leheu, J. (to Societe Creusot-Loire). French Patent 2,150,256. 26 Aug 1971. 9p. (In French).

Improvements are presented for nuclear reactors having exchangers and pumps integrated into the vessel containing the core, such types of reactor being provided with at least one primary liquid metal circuit between the core and exchangers for each exchanger. The liquid metal heats up on traversing the core and cools down on traversing the exchanger. Each exchanger circuit possesses means for feeding in and ensuring the flow thus confining the cold liquid metal returning to the core at the exchanger outlet. The hot liquid metal is contained in the vessel. (FR)

11898 APPLICATION OF THE PERTURBATION THEORY FOR CALCULATIONS OF FAST REACTORS. Tinka, I. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 8, 266-268 (Aug 1973). (In Czech).

The simplicity of the use of the perturbation theory formulas was exploited for writing down the programmes which compute temperature and power coefficients of reactivity. Doppler-effect, sodium void coefficient etc. The essential part of the report is devoted to changes of the macroscopic cross sections which are caused by changes of the temperature and the concentrations of nuclei (by mediation of the resonance selfshielding coefficients). The programmes and the possibility of their use are briefly described. (17 references) (auth)

11899 TECHNOLOGY OF SODIUM. Chemical, Physicochemical, and Metallurgical Problems in Sodium–Cover Gas–Wall Materials System. Trouve, J.; Baque, P.; Champeix, L. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 182, 61-69(Jun 1973). (In French).

Chemical, physicochemical, and metallurgical problems in the sodium, cover gas, and wall materials system considerably affect the materials chosen for these purposes as well as reactor design and operation. Technological studies were carried out on mass transfer in out-of-pile loops as well as on analyses of radioactive products in Rapsodie. Research and development programs are closely linked with the needs of fast neutron reactors in the future. (FR)

11900 FAST BREEDER REACTOR PROTECTION SYSTEM. van Erp, J. B. (to United States Atomic Energy Commission). US Patent 3,764,467. 9 Oct 1973. Filed date 22 Dec 1971. 8p.

Reactor protection is provided for a liquid-metal-fast breeder reactor core by measuring the coolant outflow temperature from each of the subassemblies of the core. The outputs of the temperature sensors from a subassembly region of the core containing a plurality of subassemblies are combined in a logic circuit which develops a scram alarm if a predetermined number of the sensors indicate an over temperature condition. The coolant outflow from a single subassembly can be mixed with the coolant outflow from adjacent subassemblies prior to the temperature sensing to increase the sensitivity of the protection system to a single subassembly failure. Coherence between the sensors can be required to discriminate against noise signals. (Official Gazette)

11901 POSSIBILITY OF ELECTROMAGNETIC SELF-EXCITATION IN LIQUID METAL FLOWS IN FAST REACTORS. Bevir, M. K. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 455-458(Oct 1973).

The possibility that the liquid metal flows in fast reactors may form electromagnetically self-exciting systems are examined and the potential consequences are considered. Simple calculations indicate that the smaller prototypes are unlikely to self-excite, but there is a possibility that the larger ones might. The pumps appear more likely to self-excite than the reactor flow systems as a whole. Lengthy calculations would be needed to establish definitely whether the flow regimes in the reactors are self-exciting or not. (auth)

11902 BOILING NOISE DETECTION. Winterton, R. H. S. (Univ. of Birmingham, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 459-462(Oct 1973).

The theory of the resonant absorption of sound by gas bubbles in a liquid is summarized, and applied to the detection of boiling noise in the sodium cooled fast reactor. It is shown that in the frequency range 50 to 500 kHz the attenuation of boiling noise due to gas bubbles could be very high. (auth)

11903 PRIMARY SYSTEM DESIGN OF SODIUM-COOLED FAST REACTORS. Campbell, R. H. (Nuclear Power Group Ltd., Risley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 357-365(Oct 1973).

Three alternative designs for pool type primary circuits and the loop type of circuit are described. The choice of refueling schemes is discussed. The relative merits of pool and loop circuits are compared, taking into consideration engineering aspects and other important features such as maintainability, ease of inspection, and safety characteristics. The development potential is also considered. It is concluded that there is no clear argument in favor of either system. The pool type appears marginally better for the first generation of large plant and loops will probably be more suitable for later larger plants. (UK)

Research, Test, and Experimental Reactors

Refer also to abstracts 10248, 10258, 10288, 10700, 10863, 11362, 11417, 11853, 11858, 11874, 12002, 12022, 12023, 12065, 12180, and 12186–12189.

11904 (BARC-694, pp 1-8) PURNIMA: A ZERO ENERGY EXPERIMENTAL FAST REACTOR AT TROMBAY. Srinivasan, M. 1973.

11905 (BARC-694, pp 135-141) PULSED FAST REACTOR PROJECT. Iyengar, P. K.; Srinivasan, M.; Nargundkar, V. R.; Subba Rao, K.; Chandramoleshwar, K.; Pasupathy, C. S.; Das, S.; Basu, T. K.; Job, P. K. 1973.

11906 (BARC-694, pp 142-144) MEASUREMENT AND CALCULATION OF FAST REACTOR PARAMETERS. Navalkar, M. P.; Iyengar, S. B. D.; Acharya, G. V.; Godwal, B. R.; Joneja, D. P.; Ramakrishna, D. V. S.; Subbukutty, K. V.; Coachman, J. C.; Phiske, M. R. 1973.

11907 (CEA-CONF-2153) USE OF CHANNELS FOR PHYSICS OF SOLIDS AND NEUTRON PHYSICS IN A REACTOR OF AVERAGE POWER: PERFORMANCE IMPROVEMENT. Berthet; Bocquet; Brissot; Buevoz; Crancon; Delapalme; Douchin; Jeandey; Perrin; Perves; Ristori; Thomas (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 13p. (In French). (CONF-721138-7; SM-165/25). Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

The methods used to improve the performance of the Melusine swimming pool reactor with respect to the neutron flux intensity, flux quality, and ease of use are briefly outlined. The installation of an on-line isotope separator for the study of the spectrometry of radioisotopes with a half-life close to a second is reported. The placement of a statistical chopper consisting of lithium ferrite in the No. 3 radial channel is described. The use of a radial channel for the study of the solid state by neutron diffraction is reported. The modifications made to a tangential channel for the on-line measurement of the Mossbauer effect and for the study and determination of crystalline structures by a modified Laue method are discussed. (JSR)

11908 (CEA-CONF-2426) METHODS OF CONTROL DEVELOPED FOR THE FABRICATION OF THE FUEL ELEMENT FOR THE GRENOBLE HIGH FLUX REACTOR. Destribats, M. T.; Papezyk, F.; Pillet, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Div. de Metallurgie et d'Etude des Combustibles Nucleaires). Jan 1973. 9p. (In French). (CONF-730606-5). Dep. NTIS (U. S. Sales Only) $3.00.

From seventh international conference and exhibition on nondestructive testing; Warsaw, Poland (4 Jun 1973).

The performances required for the fuel element of the Grenoble high flux reactor have necessitated the development of control methods. The fuel element consists of 280 plates bent in circle evolution and assembled by corona welding between two collars. The maximum neutron flux in the reflector is 1.5×10^{15} n/cm^2 and the maximum heat flux at the hot point on the plate is 500 W/cm^2. Control methods for the homogeneity of the distribution of U and B in the fuel plates are developed in detail. The method for the control of the U distribution uses x-ray absorption across the plate. The data processing adapted makes it possible to obtain on a printed tape the mean of the charge along the length of a generator and the tolerance excesses as well as the recording of the distribution profile. The results are very reproducible. The precision is 1% and the stability is good. The apparatus has been in industrial service for a year. The method for the control of the B distribution is based on the densitometric use of neutrographs. The homogeneity and stability of the neutron beam were first studied in order to define a useful work surface compatible with good precision. Standards were developed with different B contents and made it possible to test the sensitivity which corresponds to the tolerance limits. The pieces to be controlled are neutrographed simultaneously with the standards. The method gives a satisfactory control of the distribution with a precision of several percent for a tolerance of ±15%. (tr-auth)

11909 (CONF-720613-P1, pp 365-380) TESTING OF THE THERMOEMISSION REACTOR-CONVERTERS TOPAZ-I AND TOPAZ-II. Kuznetsov, V. A. (State Committee on the Use of Atomic Energy, Moscow). 1972. (In Russian).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The construction of reactor-converters and their neutron-physics characteristics are outlined. The test equipment is described. Problems encountered in measuring the electric power output of the reactor-converter are discussed. The basic results obtained are summarized. (JSR)

11910 (EUR-4861) PULSED SOURCE EXPERIMENTS WITH HEAVY WATER MODERATED NATURAL URANIUM LATTICES IN EXPO AND ECO. Birkhoff, G.; Bondar, L.; Hage, W.; Ley, J. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Oct 1972. 38p. INIS.

Several pulsed source experiments were made at Ispra in the subcritical facility EXPO and the zero power critical reactor ECO. These experiments studied the problems connected with pulsed source reactivity measurements in natural uranium, heavy water moderated reactors, which are mainly characterized by a long generation time as compared with the short living delayed neutron life time. A survey of various experimental and analytical methods applied along with the results of reactivity and generation time measurements are reported in the negative reactivity range between about 0.17 and 40 $. The results are compared with two group calculations, and systematic deviations are discussed. For the far subcritical cases a deviation of about 5% of the theoretical reactivity values remains unexplained. (INIS)

11911 (INIS-mf-849) FAST REACTOR PROGRAMME. Srinivasan, M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 20p. INIS.

India's fast reactor programme is described in detail. A 15 MW(e) Fast Breeder Test Reactor (FBTR) under construction in the Reactor Research Centre at Kalpakkam, will provide experience in construction and operation of a sodium cooled fast reactor. Fuel and material testing is an essential aspect of fast reactor development. For this purpose, FBTR will serve as irradiation facility and Radiometallurgical and Radiochemical Laboratories will provide the necessary support. A significant effort in material science is also planned. The Pulsed Fast Reactor planned for construction in the Centre will be a valuable tool for studies in radiation damage and solid state physics. The success of fast breeders is significantly dependent on efficient methods of reprocessing of irradiated fuel. Development work in reprocessing of fast reactor fuels is included in the programme of the Reactor Research Centre. An extensive programme in sodium technology, reactor component development and testing and fast reactor instrumentation is also planned. Establishment of fuel fabrication technology will be undertaken at Trombay in the first instance. The test reactor and the various laboratories will be in operation by 1976–77. The design of a proto-type fast breeder will commence in 1974 to permit construction by the end of the decade. (auth)

11912 (INIS-mf-867) RADIATION SHIELDING OF THE PROPOSED THERMAL RESEARCH REACTOR. Chamany, B. F. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The design criteria and the methods of calculation adopted in the design of the radiation shield of the Thermal Research Reactor, Trombay, India (TRR) are described. The main components of the shield such as the top and radial shield of the reactor, the heat exchanger shield, the fuelling machine shield, etc. are described. The important parameters such as neutron and gamma fluxes and dose rate distribution, heat generation rate, etc. are presented. (auth)

11913 (INIS-mf-882) NUCLEAR INSTRUMENTATION SYSTEM OF THE FAST BREEDER TEST REACTOR. Sangodkar, D. B.; Paziaud, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 12p. INIS.

Nuclear instrumentation in the Fast Breeder Test Reactor (FBTR) at Kalpakkam has been designed to provide for the control and the safety of the reactor. At the detector locations in the biological shield, the flux is thermalized and conventional thermal neutron detectors are used for the flux measurement. Ranges of flux and the considerations in the choice of detectors and their location are discussed. Various measures (parameters) available for read-out from shutdown to full power operation of the reactor are described. The safety actions and interlocks provided by the system and general realiability and safety criteria that have led to the system in its present form are discussed. The advantages of a reactivity meter as a means of protective action in preference to a period-meter are also discussed. Finally, a brief summary of the development effort and programme of tests being carried out to ensure reliability of instrumentation is presented. (auth)

11914 (INR-P-1420) SOME ADVANTAGES OF THE REACTOR DYNAMICS MODELS WITH POWER FEEDBACK. Bouzhyk,

Ya.; Gadomski, A.; Topa, E. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 14p. (In Russian). INIS.

An approach to the model of the reactor dynamics of a research reactor based upon the power reactor feedback only is presented. The advantages of such an approach are shown and the comparison of the results with the experimental data is given. The model developed and the numerical programs elaborated have been applied to evaluate the reactivity of the control rod in a reactor working on various power levels. (auth)

11915 (RCN-190) FAST REACTOR PROGRAMME. Second Quarter 1973 Progress Report. Hoekstra, E. K. (comp.). Stichting Reactor Centrum Nederland, Petten (Netherlands)). Aug 1973. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

The measured and re-calculated spectra of the cores STEK-1000, 2000, 3000 and 4000 as well as the reactivity worths of isotopes and elements measured in STEK 2000 and 3000 are presented. Results are given of the post-irradiation examination on fuel pin R54-F25 which failed after an in-pile burst test lasting 240 minutes; the prolonged loss-of-cooling experiment R63-L07 is described. Lattice parameter, phase diagram and thermodynamic studies on U(C,N) are reported. A recently begun study on the phases of the Cs–U–O system is introduced. Preparations and initial results regarding the determination of neutron radiation damage in austenitic steel 1.4949 are described. Limits of detection found in the emission spectrographic analysis of impurities in sodium are given. The effects of condensing water on the stability of gold, platinum and platinum oxide aerosols in a PERVEX box are reported. Failure of a seven-rod bundle during commissioning of the sodium test loop recently adapted for 500 kW heat removal is described and design considerations connected with the planned local boiling experiment in a 28-rod bundle are given. (auth)

11916 HYDROGEN COLD NEUTRON SOURCE CALCULATIONS FOR DIFFERENT ORTHO/PARA MIXTURES. Kalli, H. (Helsinki Univ. of Tech.). Nucl. Instrum. Methods; 113: No. 3, 461-463(1973).

The results of Monte Carlo calculations of a cylindrical hydrogen cold neutron source in a tangential beam tube are discussed. The dependence of the cold neutron output on the relative ortho/para abundance was studied at the hydrogen boiling temperature 20.4°K. With a suitable choice of moderator cylinder length the output was found to be independent of the ortho/para mixture. The maximum output was obtained with a mixture rich in parahydrogen. (auth)

11917 PEC REACTOR PROJECT. Pierantoni, F. (CNEN, Bologna). Nucl. Eng. Int.; 18: No. 209, 797-800(Oct 1973).

PEC is a specialized facility conceived for the testing of prototype subassemblies under fully-representative conditions typical of a large fast sodium-cooled power plant. It is designed for both steady-state endurance trials and "testing-to-the-limits," to ascertain experimentally the operational margins. The reactor concept is centered on the use of independent, closed test loops, for experimental and operational flexibility. The plant is described and parameters are given for the driver fuel elements. Supporting research and development work is discussed and the more important out-of-fuel facilities are tabulated. (UK)

11918 HEALTH PHYSICS ASPECTS OF THE EXPLOITATION AND DEFUELLING OF BR3-2 WITH CONTAMINATED PRIMARY CIRCUIT. Gubel, P. (Centre d'Etude de l'Energie Nucleare, Mol, Belg.). pp D.6.1-D.6.17 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

The health physics aspects related to the operation and dismantling of the BR3 reactor during the year 1970 are discussed. As expected, radiation fields in the basement of the auxiliary building increased with time in such a manner that from July on, access to the basement was only allowed in co-operation with the Health Physics Service, who checked the airborne activity and the estimated dose before each job. Routine operating checks were reduced to avoid overexposure of workers. Maintenance of the purification pumps and in the surge-tank room was only possible during reactor stops and after planned releases of active gases. Airborne activity in the containment building and in the basement of the auxiliary building were continuously monitored for active gases, dust, and iodine-131. Iodine-131 activity generally remained well under the MPC (6.10^{-9} μCi/cm^3) level. (auth)

11919 FEYNMAN-α EXPERIMENT ON UTR-KINKI. Niwa, T.; Tajo, T.; Konuki, T.; Yasui, Y.; Tanaka, H. (Kinki Univ., Fuse, Japan). Kinki Daigaku Genshiryoku Kenkyusho Nenpo; 9: 1-9(In Japanese).

Prompt neutron decay constant α on UTR-Kinki was measured by Feynman method. The construction of gate pulse generator must be completed in order to use the instruments that were already in possession. The gate pulse generator was set up for the trigger pulse generator, constructed with unijunction transistors and silicone control rectifiers, and the start-stop pulse generator constructed with monostable multivibrators. Using the set, Feynman method could easily be applied to UTR-Kinki. (auth)

11920 STEAM CYCLE OF THE FR2. Perinic, D.; Schmidt, T. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 8-13(1973). (In German).

Following a brief explanation of the requirement of the experimental circuit, the use of irradiation and the circuit are described in detail. The installed experimental equipment within the test circuit is described and the safety problems discussed. The operation of the test equipment is summarized. (GE)

11921 CONCERNING THE DEVELOPMENT OF DISPERSION FUEL PLATES FOR HIGH-FLUX REACTORS. Dienst, W.; Nazare, S.; Ondracek, G.; Thuemmler, F. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 35-39(1973). (In German).

A short description of canning material and fuel (uranium–aluminade in an aluminium matrix) is followed by an explanation of the peculiarities of the plate technology (picture frame technique). The irradiation behavior of the plates is investigated (irradiation in the FR 2). (GE)

11922 SELF-LIMITING POWER EXCURSION CHARACTERISTICS OF LIGHT WATER REACTORS. Theoretical Analysis of HTR Pulse Operation by REACT, a Two Point Kinetics Code. Nishikawa, M. (Tokyo Atomic Industrial Research Lab., Ltd., Kawasaki, Japan); Kawai, T. J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 329-338(Jun 1973).

The theoretical analysis code named REACT, devised for covering pulsed operation of the HTR, is based on a two-point kinetic model, one point representing the average of the core, while the other is optional (e.g. hottest spot). The behavior of reactor power and other parameters is calculated by the average point, and the temperature of the hottest spot by the other point at same time. Improvements were brought to the code based on experimental data, and good agreement was found between calculation and experimental results obtained for pulsed operation. The feedback reactivity due to the Doppler effect was comprehensively evaluated by recalculation of experimental data; the void behavior was also investigated. (auth)

11923 IN-SERVICE INSPECTION OF THE BR3 REACTOR IN MOL. Watkins, B. (Nondestructive Testing Centre, Warrington, Eng.). Non-Destruct. Test. (Guildford, Engl.); 6: No. 4, 191-194 (Aug 1973).

A remote non-destructive inspection of parts of the pressure vessel and the reactor internals of the Belgian BR 3 reactor was carried out by the Reactor Plant Inspection Service of REML/UKAEA in December 1971. The inspection was done under 1.5 to 15.0 m of water apart from the nut and stud examination which was done dry. Inspection of the internal surface of the pressure vessel was accomplished with a general-surveillance television camera equipped with zoom lens and close-up attachments, for which all the controls were at a console on the reactor containment floor. The results of the ultrasonic examination of the shell were shown with a radar method of presentation. For the inspection of cracks at the roots of the threads of closure studs and nuts both ultrasonic and eddy-current techniques were used. One hundred and twenty visitors representing nearly 55 European and US utilities and a number of licensing authorities attended the inspection. (UK)

11924 TEMPERATURE TIME BEHAVIOUR IN THE MTR TYPE FUEL ELEMENTS OF THE FRG-2 AFTER SHUTDOWN OF THE PRIMARY PUMP. Krull, W.; Roebert, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Geesthacht, Ger.). Atomkernenergie; 21: No. 4, 292-296(1973). (In German).

In the two core-configurations of the FRG-2 the temperature as a function of the time elapsed after shut down of the primary pump was determined in the plates of the MTR-type fuel elements. The measurements were conducted at several power levels (1 to 15 MW). Particularly the temperature as a function of the time was investigated for emergency conditions: both of the convection flaps (10 to 15 MW), only one of the flaps open (8 to 15 MW), both of the flaps closed (1 to 1.5 MW). It is concluded, that in an emergency (failure of the primary pump and failure of one convection flap) no excessive temperature will occur. This conclusion is valid for the present maximal power level of 15 MW as well as for the power level of 21 MW applied for. (GE)

11925 SLOWPOKE: A NEW LOW-COST LABORATORY REACTOR. Kay, R. E. (Chalk River Nuclear Labs, Ont.); Stevens

Guille, P. D.; Hilborn, J. W.; Jervis, R. E. Int. J. Appl. Radiat. Isotop.; 24: No. 9, 509-518(Sep 1973).

SLOWPOKE is a new type of nuclear reactor for laboratories, universities, hospitals and research institutes. It is a safe, reliable, low-cost source of neutrons for isotope production and neutron activation analysis. The reactor has a number of novel features including inherent safety and unattended operation. The prototype reactor is now installed at the University of Toronto. During the first 18 months of operation the reliability and utilization of this facility has exceeded expectations. (auth)

11926 RESONANCE SCATTERING EFFECTS IN EBR-2 REFLECTOR AND STRUCTURAL-SUBASSEMBLY REGIONS. Meneghetti, D.; Phillips, K. E. (Argonne National Lab., IL). J. Nucl. Energy; 27: No. 8, 559-575(Aug 1973).

Detailed fine-energy spectra in the energy range of resonance scattering effects are shown for an EBR-II type core radially surrounded by steel-rich or nickel-rich reflectors and for steel-rich or nickel-rich subassembly-sized regions internal to an EBR-II type core. Results of use of fine-group-collapsed spatially dependent and spatially independent coarse-group cross sections for simulations of the resonance scattering effects are described. (auth)

11927 SHORT-TERM IRRADIATION AND POST-IRRADIATION EXAMINATION OF THERMIONIC EMITTERS. Huebner, H. (Erlangen-Nuernberg Univ., Ger.). Kerntechnik; 15: No. 6, 273-280(1973). (In German).

The technological adequacy of the thermionic emitters of the incore thermionic reactor (ITR) was tested in an irradiation program in the reactor FR 2, Karlsruhe. The irradiation capsule developed for this purpose is described in some detail. It was tested in a short-term irradiation experiment in which the emitters were exposed to a temperature of 1,860°C for 35 hours. The post-irradiation examination findings are reported. The observed early phases of fuel migration can be explained by material transport by sublimation and by surface diffusion. (GE)

11928 LOW-TEMPERATURE VERTICAL CHANNELS IN IRT-2000 REACTOR. Vadachkoriya, L. A.; Katsitadze, D. G.; Mumladze, Sh. A.; Naskidashvili, I. A.; Tavkhelidze, G. P.; Topchyan, L. S.; Chipashvili, A. A. (Inst. of Physics, Tbilisi, USSR). Inzh.-Fiz. Zh.; 25: No. 3, 430-435(Sep 1973). (In Russian).

Two types of low-temperature vertical channels, with forced circulating helium as a heat transfer agent and liquid nitrogen as a coolant, designed for intra-channel investigations of physical and mechanical properties of materials at low temperatures under irradiation are described. Experimental data for the temperature dependence on the reactor power in both installations under similar conditions and data on sample temperature dependence on the reactor power in the installation of the second type in the experiment with bulky probe are presented. (8 references) (auth)

11929 NEUTRON PULSE MEASUREMENTS AT ZERO POWER REACTORS. Blumentritt, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 7, 213-217(Jul 1973). (In German).

Techniques used for neutron pulse measurements applied to determinations of reactor parameters at zero power systems are described. Selected experiments on the determination of prompt neutron decay constants and of reactivity will give an idea of the capacity of this technique. (auth)

11930 ANALYSIS OF THE NEUTRON NOISE OF THE CROCUS REACTOR. Chartier, P.; Haldy, P. A. (l'Ecole Plytechnique Federale, Lausanne, Switzerland). Z. Angew. Math. Phys.; 24: No. 2, 248-254(1973). (In French).

An application of stochastic reactor kinetics theory has been made to determine the mean neutron lifetime in the lightly enriched uranium, light water reactor CROCUS. This quantity was obtained by intercorrelation of noise signals from two ionization chambers. The same method was also used to determine the efficiency of the ionization chambers. (auth)

11931 SAFETY CRITERIA APPLIED IN THE DESIGN OF POLISH TEST REACTOR MARIA AND EVALUATION OF THE EFFECTIVENESS OF THE PROPOSED CONTAINMENT SYSTEM. Nycz, C. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 18: No. 6, 255-263(1973).

In the design of the Polish high flux test reactor (30 MW) the evaluation of the possible sequences of accidents was performed and the maximum credible accident chosen. A failure of the pressure loop in the reactor core followed by the SPERT-type nuclear excursion and rupture of the remaining pressure loops in the core appeared to be the most dangerous sequence of the credible accidents. For this case the time-dependence of the pressure build-up in the containment and the activity release to the environment were evaluated taking into account the ventilation system characteristics and the semi-tightness of the concrete containment building. (auth)

11932 SAFETY PROBLEMS ASSOCIATED WITH THE IRRADIATION OF SAMPLES IN THE CORE FACILITIES OF THE TRIGA REACTOR AT 1 MW. Di Palo, L. Ing. Nucl.; 13: No. 4, 11-18 (1972). (In Italian).

In order to verify the validity of the technical directions relative to mobile experiments, the safety problems associated with the irradiation of samples of given specifications in the experimental equipment connected directly to the core of the TRIGA reactor at 1 MW were analyzed. (tr-auth)

11933 MEASUREMENT OF THE EFFECTIVE DELAYED-NEUTRON FRACTION IN THREE DIFFERENT CORES OF THE FAST ASSEMBLY FRO. Moberg, L.; Kockum, J. (AB Atomenergi, Studsvik, Sweden). Nucl. Sci. Eng.; 52: No. 3, 343-349 (Nov 1973).

The effective delayed-neutron fraction, β_{eff}, has been measured in three cores of the fast zero power reactor FRO. The variance-to-mean method, in which the statistical fluctuations of the neutron density in the reactor are studied, was used. The experimental results were compared with theoretical values of β_{eff} calculated with perturbation theory. The difference was at most 10%, which should be compared to the accuracy in the experimental values of ~3%. (auth)

11934 PRINCIPLE AND DEVELOPMENT PROBLEMS OF MEDICAL REACTOR. Kanda, K. (Kyoto Univ., Osaka). Genshiryoku Kogyo; 19: No. 1, 52-56(Jan 1973). (In Japanese).

Present status and problems when neutron flux from nuclear reactors is directly used for cure are introduced. In 1951, (n, α) reaction of thermal neutrons was used for the cure of cerebral tumor for the first time, and in 1959, a medical research reactor was constructed in Brookhaven National Laboratory. Principle of the curative method by neutron capture is as follows. Stable isotopes, which have large cross-section for neutron absorption and emit some heavy particles when they absorb neutrons, are concentrated in tumors before hand. Neutron beam is irradiated on the tumors, and high energy radiation emitted breaks tumor tissue selectively. When enriched boron-10 is employed, boron-10 from 20 to 45 μ g is concentraged per 1 g of cerebral tumor, but to normal tissue of 1 g, less than 0.3 μ g is concentrated. Thermal neutrons are suitable to the cure of tumors near skin because of short mean free path. Epithermal neutrons are suitable to the cure of deep diseased parts. Conditions required for the medical reactors are as follows. The thermal neutron flux is more than 3×10^9 n/cm·sec. Neutrons other than the thermal neutrons do not mix. Mixing ratio of gamma ray is small. Irradiation time can be selected freely. (JA)

11935 ANALYSIS OF SODIUM VOID REACTIVITY MEASURED IN FCA V-1 ASSEMBLY. Nakagawa, M.; Takano, H.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 419-427(Jul 1973).

The analysis of sodium void reactivity measurements has been performed. The measurements were made in the FCA V-1, which is a fast critical assembly intended for physics mock-up of the experimental fast reactor "JOYO". The voided zones were the central region of the core and channel drawers extending throughout the core height. The calculations were performed using the JAERI set with 70-group structure. As a result it was found that the conventional two-dimensional calculations underestimate measurements by about 10 to 40% in the core region. However, if the axial streaming effects are considered, the ratio between calculations and experimental results become about 0.9 for almost all cases of channel void. The streaming effects are calculated with use of Benoist's formula of anisotropic diffusion coefficients. The heterogeneity effects on the spatial neutron flux distribution are taken into consideration by the collision probability method. The effect is large in the central part of the core (about 20% negative reactivity). The elastic removal cross sections are precisely obtained for the predominant resonances of light elements and compared with the conventional set. The influence on sodium void reactivity is not so large in this assembly. (auth)

11936 CORRELATION OF AMOUNTS OF TRANSPLUTONIUM NUCLIDES WITH BURNUP IN THE JPDR-I SPENT FUEL. Umezawa, H.; Ichikawa, S. I.; Suzuki, T.; Okashita, H.; Natsume, H. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 489-492(Aug 1973).

The amounts of ^{241}Am, ^{242}Cm and ^{244}Cm were determined by means of a radiochemical technique in several specimens taken from the spent fuel of the JPDR-I. The yields of the transplutonium nuclides were examined in connection with the burnup determined by a conventional method. It was found that the burnup correlates well with the yield ratios of various transplutonium nuclides. (auth)

11937 INTER-UNIVERSITY JOINT USE OF GOVERNMENT NUCLEAR FACILITIES IN JAPAN. II. Research Reactor Institute, Kyoto University. Shibata, T. (Kyoto Univ.). Nippon Genshiryoku Gakkaishi; 14: No. 11, 614-618(Nov 1972). (In Japanese).

Overall facilities were completed and a research reactor attained criticality by June 1964. Two months later, full output operation at 1,000 kW was carried out successfully. The Research Reactor Institute had already been founded in the preceding year. Circumstances for installation, outline of the facilities, their management and operation, general situation of the utilization of facilities, and future plans are described. Major facilities are the swimming-pool, tank type research reactor of 5,000 kW(t), a 46 MeV electron linear accelerator and a 10,000 Ci ^{60}Co irradiation facility. Total of about 8,000 people per year visit and use the facilities; as for the research reactor, beam experiment is on the increase. For the future, replacement of the existing research reactor by a high neutron-flux one, and also installation of a critical assembly are being considered. (JA)

11938 EFFECT OF REFUELLING ON DOSE RATE IN AN IRRADIATION FACILITY. Zarand, P.; Santha, A.; Mandi, E.; Koblinger, L. (Orszagos Frederic Joliot-Curie Sugarbiological es Sugaregeszsegugyi Kutato Intezet, Budapest). Phys. Med. Biol.; 18: No. 6, 842-847(Nov 1973).

The effect of core rearrangements on the dose rate, contamination and the neutron spectrum were studied by physical measurements and biological experiments at the thermal reactor of the Central Research Institute for Physics, Budapest. The neutron spectrum was characterized by the ratio of effective neutron fluence rates measured with In and S. This fluence ratio, the neutron fluence and dose rate normalized to unit MW reactor power, as well as contamination are characteristic of the shielding. Physical measurements are consistent with the percentage survival patterns of CFLP white mice. (auth)

11939 OPERATION EXPERIENCE OF JPDR (JAPAN POWER DEMONSTRATION REACTOR). Suguri, S.; Sasaki, S. (Japan Atomic Energy Research Inst., Tokyo). Genshiryoku Kogyo; 19: No. 1, 30-34(Jan 1973). (In Japanese).

JPDR is a 45 megawatt boiling water reactor of natural circulation and direct cycle type, which reached criticality on August 22, 1963. The reactor core was remodeled in 1969, and converted to the 90 megawatt boiling water reactor, JPDR-II of forced circulation and direct cycle type. Gamma-probe test for the measurement of power distribution was performed five times from 1963 to 1970. From July to September in 1965, independent periodical inspection was performed. When the periodical inspection was performed from May to September in 1966, hair-cracks were discovered on the top cover of a reactor pressure vessel. Because of the possibility of other hair-cracks, inspection of the inside of the pressure vessel was performed by electrical resistivity probe method, ultrasonic method and liquid penetrant method. This inspection resulted in the discovery of hair-cracks on the vessel wall near west side forced circulation nozzle. In September 1969, the reactor core was remodeled, and power was doubled. Since February 1972, power up test of the JPDR-II has been performed. Utilization rate before the remodeling of the reactor core was about 30 percent. (JA)

11940 IRRADIATION SUBASSEMBLY. Seim, O. S.; Filewicz, E. C.; Hutter, E. (to United States Atomic Energy Commission). US Patent 3,767,525. 23 Oct 1973. Filed date 6 Oct 1972. 4p.

An irradiation subassembly for use in a nuclear reactor is described which includes a bundle of slender elongated irradiation capsules or fuel elements enclosed by a coolant tube and having a yieldable retaining liner between the irradiation capsules and the coolant tube. For a hexagonal bundle surrounded by a hexagonal tube the yieldable retaining liner may consist either of six segments corresponding to the six sides of the tube or three angular segments each corresponding in two adjacent sides of the tube. The sides of adjacent segments abut and are so cut that metal-to-metal contact is retained when the volume enclosed by the retaining liner is varied and springs are provided for urging the segments toward the center of the tube to hold the capsules in a closely packed configuration. (Official Gazette)

11941 METHOD FOR THE PRODUCTION OF A NEUTRON IMPULSE FLASH AND A NUCLEAR REACTOR FOR ITS REALIZATION. Gassiev, I. A.; Kiknadze, G. I.; Garsevanishvili, G. N.; Akhobadze, V. N. US Patent 3,761,351. 25 Sep 1973. Priority date 28 Jan 1970, USSR. 6p.

A method for the production of a neutron impulse flash is described which requires that nuclear fuel is placed outside a neutron moderator both before and after a neutron impulse flash and is shot through the moderator to produce the flash. An apparatus is described which uses nuclear fuel and a neutron-moderator vessel having at least one through conduit for the nuclear fuel disposed in the conduit so that the fuel can be shot along the conduit by a suitable means to produce a neutron impulse flash. (Official Gazette)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 11924 and 11927.

11942 POSSIBILITIES OF THE UTILIZATION OF NUCLEAR REACTORS IN INDUSTRIAL SYNTHESIS OF CHEMICAL COMPOUNDS. Borisov, E. A.; Timogeev, V. D. Zh. Vses. Khim. Obshchest. im. D. I. Mendeleeva; 18: No. 3, 323-327(1973). (In Russian).

A review with 65 references analyzing the possibilities of the utilization of nuclear reactors as a source of radiation during chemical processes is given. Depending on the type of irradiation, in the active zone of the nuclear reactor, there form two methods for direct utilization of the radiation for chemical synthesis—chemonuclear and nuclear-chemical. Examples are reported of these processes that were carried out by one of these methods: oxidation of nitrogen, synthesis of hydrogen cyanide, hydrazine, ozone, decomposition of carbon dioxide, synthesis of ethylene glycol, phenol, and other processes. In connection with increased utilization of nuclear reactors, the feasibility and desirability of the production of chemical substances using reactor irradiation is discussed. (JPRS)

11943 PROBLEMS OF MATERIAL CONVERSION INVOLVING DIRECT USE OF NUCLEAR FISSION ENERGY. Reetz, T. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 8, 234-239(Aug 1973). (In German).

Use of process heat from nuclear reactors shall revolutionize the processes of material conversion. As against that, direct conversion of nuclear fission energy into chemical energy is of secondary importance. Reactions in the chemonuclear reactor and in gamma-irradiation loops might gain momentum for direct conversion. But chemonuclear synthesis hitherto does not seem to be competitive as compared with the conventional techniques of material conversion because of both the very low G value and the complex technological and decontamination problems. Therefore, a chemonuclear reactor shall not be erected within the foreseeable future. Gamma-irradiation loops loaded with molten indium alloys enable the nuclear reactor to be used as a large radiation source. As to their capacity irradiation loops correspond to large ^{60}Co facilities while irradiation costs can be reduced to a small fraction as compared with those of ^{60}Co. Industrial use of irradiation loops should be expected in this very decennium. (auth)

11944 ACCUMULATION OF ^{252}Cf IN THE CENTRAL CHANNEL OF THE SM-2 REACTOR. Gavrilov, V. D.; Zamyatnin, Yu. S.; Ivanenko, V. V.; Yakovlev, G. N. At. Energ. (USSR); 35: No. 1, 33-35(Jul 1973). (In Russian).

Basic results are presented for an investigation of ^{252}Cf accumulation in ^{242}Pu and ^{243}Am specimens irradiated in the central channel of the SM-2 reactor. The use of activation detectors made it possible to obtain information on neutron activity build-up in specimens subjected to irradiation for a period of time from 50 days to 2 years. A comparison of the experimental data with data for the HFIR reactor shows that the ^{252}Cf accumulation rate increases in a reactor having a harder neutron spectrum. (3 figures, 3 references.) (auth)

11945 FR2 AND ITS EXPERIMENTAL USE. Steiger, W. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 5: No. 2, 1-7(1973). (In German).

The operation of the FR-2 reactor is described, paying particular attention to disturbances and improvements. Five large test circuits permitted a wide range of experimental test programs to be carried out. (GE)

11946 NUCLEAR STEELMAKING. A Report on the Meeting of Experts from the Nuclear and Steelmaking Industries of Europe Organized in London on 6 June by the British Steel Corporation and the British Nuclear Forum. Nucl. Eng. Int.; 18: No. 207, 649-650(Aug 1973).

A summary is given of the meeting of experts from the nuclear and steelmaking industries in which short presentations were made for purposes of discussion. Increased interest is being shown in nuclear heat as a result of doubts over the long term availability of high-quality coking coal for steelmaking. A vertical shaft process was suggested for reduction of iron ore, in which pellets of iron oxide are reduced by a stream of almost pure hydrogen at about 850°C, the hydrogen gas would be produced by catalytic

gas reforming process which was outlined, nuclear heat being used. A conceptual design of a 2500 MW(t) helium-cooled, very high temperature reactor was presented and a fairly detailed paper was given on development work on ceramic heat exchangers. The main topics in the discussion on the problems of associating a nuclear reactor with a steelworks are summarized. (UK)

11947 DESIGN AND OPERATIONAL FEATURES OF THE LOW TEMPERATURE FISSIOCHEMICAL LOOP. Sato, S.; Moriyama, N.; Ikezoe, Y.; Ishii, T.; Hirata, M. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 375-384(Jun 1973).

A low-temperature in-pile loop for the irradiation of chemical reactants, especially by fission fragments, was designed, constructed, and operated successfully. The main features of the loop are briefly described: the capsule for sample irradiation, the design and performance of the helium cooling system, and safety considerations. Gaseous chemical reactants charged in an instrumented double capsule at pressures up to 20 kg/cm^2, can be irradiated in a nuclear reactor at any temperature between +20 and −190°C, for periods up to 5 hr. The thermal performance of the helium cooling system was in good agreement with the design calculations. Irradiations of ethylene and other gases can be conducted at an absorbed fission fragment dose rate of about 20 Mrad/hr, which is several times larger than the background reactor radiation. Thus, chemical reaction studies by fission fragments can be safely conducted at ambient to low temperatures in this loop. (auth)

11948 MEASURING GAMMA RADIATION FIELDS IN REACTOR CHANNELS AND SPENT FUEL ASSEMBLIES WITH AN IONIZATION CHAMBER MEASUREMENT OF EXPOSURE DOSE RATE. Mukhachev, B. V.; Neverov, V. A.; Samoylov, P. S. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 56-62(1972). (In Russian).

The sensitivity of ionization chambers (IC) to neutrons of different energies was evaluated. The sensitivity of IC to neutrons with 2.4 and 15 Mev energy was determined on a neutron generator of HG-200 type. The derived evaluations made it possible to measure the exposure dose rate Pγ of γ-radiation in channels of the SM-2 nuclear reactor. Upper-level distributions of Pγ for channels No 16 and 111K and for the assembly of worked-out fuel elements are presented. The Pγ drop in time was measured in the No 16 channel center at instantaneous shutdown of the nuclear reactor. (JPRS)

11949 EXPERIENCE DRAWN FROM THE ALPHA CONTAMINATION OF THE BR2 REACTOR TO THE FAILURE OF AN AMERICIUM CAPSULE. Baugnet, J. M.; Leonard, F. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). pp D.5.1-D.5.5 of Safety Measurements in Nuclear Research. Fieuw, G. (ed.). Mol, Belgium; Centre d'Etude de l'Energie Nucleaire (1972).

From proceedings of the tripartite meeting on safety measurements in nuclear research; Brussels, Belgium (19 Apr 1971).

In 1967, the BR2 reactor was shut down for two months as a result of alpha contamination due to the failure of an americium capsule which was being irradiated. Alpha contamination was found on the baskets as well as in the primary circuit, the reactor pool and handling canal and also on certain working surfaces within the containment building. Spectrometric determination showed that the principal contaminant was ^{242}Cm (half-life 162.5 d) daughter product of ^{241}Am. The decontamination of the water and especially of all surfaces exposed to the water, was found to be far more complex, since it seems that the majority of the contaminant was not in ionic form, but existed in a colloid, or pseudo-colloid, in suspension or adsorbed onto the surfaces. It is estimated that it is possible to detect a failed capsule within one day, probably within one hour, by combining different methods of checking the reactor primary coolant, as follows: continuous overall checks on fission product levels and the alpha contamination level; daily checking of a representative sample for alpha activity; and spectrometric analysis α, β and γ of the water taken from the channels where singly contained samples are loaded. In certain cases, a tracer gas can also be used. (BE)

11950 METHOD AND DEVICE FOR THE USE OF HIGH-TEMPERATURE HEAT-ENERGY, IN PARTICULAR OF NUCLEAR ORIGIN. Souriau, D. (to Gaz de France). US Patent 3,761,352. 25 Sep 1973. Filed date 18 May 1972. 6p.

This patent relates to the recovering of the high-temperature heat-energy dissipated in the core of a nuclear reactor. A tin cycle is used in which stannic oxide (SnO_2) is decomposed at high temperature into a gaseous mixture of stannous oxide (SnO) and oxygen (O_2) which, after cooling, gives solid stannous oxide (SnO) and oxygen. Then stannous oxide is allowed to dismute into stannic oxide (SnO_2) which is recycled and into tin which is used to decompose water steam (H_2O) into (H_2) and into stannic oxide (SnO_2) which is recycled. (auth)

Propulsion and Package Reactors

Refer also to abstracts 10002, 10005, 10585–10587, 10591, 10644, 11762, 12182, and 12183.

11951 (AD-762193) MH-1A CORE 4 PHYSICS REPORT. Helms, S. A.; Hollis, H. D. (Army Engineer Reactors Group, Fort Belvoir, VA. Engineering Div.). 16 May 1973. 29p. (ED-7216). NTIS.

The results of core physics testing on MH-1A Core 4 are presented. These tests were conducted during Feb 1973 immediately prior to power operation. (auth)

11952 (CONF-720613-P1, pp 1-14) APPLICATIONS FOR INCORE THERMIONIC REACTORS. Rasch, W. (DFVLR, Brunswick). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The applicability of incore thermionic reactors (ITR) as autonomous energy power systems for space and underwater missions, specifically missions related to technical programs under consideration in European countries, are discussed. The physical and electrical characteristics of ITR power systems are compared with other power systems such as solar arrays and with radioisotope-fueled and reactor-heated thermoelectric and Brayton cycle systems. Cost and availability estimates are made. It is concluded that ITR's should be developed as soon as possible for use in European programs in underwater and space technology. (LCL)

11953 (CONF-720613-P1, pp 15-33) UNDERSEA APPLICATION OF THERMOELECTRONIC REACTORS. Clemot, M.; Devin, B. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The validity of using thermoelectronic reactors for undersea power sources is examined. The adaptation of reactors to offshore needs is discussed considering the conditions of use and the limitations placed on a fixed exploration system so that reactors can be compared technically and economically with other immersible and non-immersible power sources. Performance-cost optimization of an immersible integrated reactor is discussed. (JSR)

11954 (CONF-720613-P1, pp 95-106) COMPARISON OF THERMIONIC REACTOR DESIGNS EMPLOYING A COMMON THERMIONIC FUEL ELEMENT. Fisher, C. R.; Merrill, M. H. (Gulf General Atomic Co., San Diego, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Thermionic reactor designs for a number of applications are compared. Applications include space electric power at 10 and 40 kW(e) for auxiliary power and 120 kW(e) for electric propulsion. The applicability of the basic thermionic fuel element technology to a large variety of special power requirements is emphasized. (auth)

11955 (CONF-720613-P1, pp 107-119) ASPECTS ON THE MODULAR LAY-OUT OF INCORE THERMIONIC REACTORS. Pruschek, R. (INTERATOM, Bensberg, Ger.); Gross, F; Stehle, H. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Various constraints have to be considered for the lay-out of an incore thermionic reactor. In addition to considering the thermophysical properties, the behavior of materials, and thermionic diode performance characteristics, the envisaged applications involve additional boundary conditions and design criteria. These are: high specific power; low cost of a thermionic reactor power generation system; low energy cost; and long life and low fuel inventory. Also the properties of the environment in which the reactor will be operated (vacuum, air, water) influence the reactor design. However, it will be possible to assemble a variety of application-modified incore thermionic reactors from two basic fuel elements: the thermionic fuel elements and the driver fuel rods. Both fuel element types are under development. The difference in fuel costs between modular, moderated Mo-cores as well as for fast and epithermal W-cores (both of the driver reactor concept) are presented for both, space and maritime applications. (auth)

11956 (CONF-720613-P1, pp 121-131) CORE DESIGN OF INCORE THERMIONIC REACTORS. Gregorius, K.; Janner, K.; Kammerer, P. (Siemens AG, Erlangen, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Two varieties of Incore-Thermionic Reactors are described. The first type is characterized by a relatively soft neutron spectrum and a small fissionable fuel loading (approx. 17 kg U with 93% ^{235}U). The development of this reactor is relatively far advanced; the state of technical development is briefly outlined. The second type has a relatively hard neutron spectrum and a correspondingly high fuel loading (approx. 70 kg U with 93% ^{235}U) and makes possible the transition to a fast reactor. Work on this type was carried out with a view to possible cooperation with research groups in the USA. Characteristic core data for both types are summarized in table form. (auth)

11957 (CONF-720613-P1, pp 133-139) 20-kWe UNDERSEA THERMOELECTRONIC REACTOR PROJECT. Devin, B.; Dupuy, G.; Schwartz, J. P. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The basic considerations in the planning of an undersea reactor are flexibility, simplicity of use, and economy. Once installed undersea it must be capable of furnishing electrical current and heat for its lifetime without human control except for connecting electrical cables, start-up, and shut-down. The natural water cooled and moderated reactor selected has a casing for the primary circuit which is in equilibrium with the sea pressure. The sea pressure is used to pressurize the primary circuit. The core, control, primary circuit, and protection are described. The safety of the reactor is discussed. (JSR)

11958 (CONF-720613-P1, pp 141-153) PROBATORY GENERATOR DIOGENE. Bliaux, J. (CEN, Saclay, France); Alleau, T.; Franzetti, F. 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Since 1965 the CEA has had a program for the in-pile irradiation of thermionic converters. The DIOGENE program has the purpose of irradiating two 10-kW(e) thermionic generators in the Triton-II until 1975. The JOB 01 generator, consisting of a converter, bar, and heat exchanger, is described. The irradiation device, the adaptation of the reactor, and the test instrumentation are also described. (JSR)

11959 (CONF-720613-P1, pp 155-166) HIGH-VOLTAGE THERMIONIC REACTOR USING DOUBLE-SHEATH FUEL ELEMENTS. Schock, A. (Fairchild Space and Electronics Div., Germantown, MD). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A novel design concept for a "flashlight-type" in-core thermionic reactor is described. This concept, called the "double-sheath" design in contrast to the previously considered "wet-sheath" and "dry-sheath" concepts, permits the build-up of high reactor output voltages, without the danger of cesium breakdown and shorts-to-ground. In addition to a description of the design and its functional components, a brief discussion of suggested fuel element fabrication and reactor assembly techniques is presented. The proposed design offers the potential of high reliability because only insulators at very low potentials (e.g. < 3 volts) are in contact with cesium vapor; because there are no ceramic or cermet seals within the reactor (all are outside, beyond the reflectors); and because all vacuum - tight joints in the reactor are between ductile niobium components. (auth)

11960 (CONF-720613-P1, pp 167-187) ELECTRONIC TEMPERATURE-FLATTENING OF THERMIONIC REACTORS. Schock, A. (Fairchild Space and Electronics Div., Germantown, MD). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A method for electronically temperature-flattening a "flashlight-type" thermionic reactor with both axial and radial heat generation nonuniformities is described. The method, which makes use of compensating electron cooling variation while satisfying the voltage- and current-matching constraints on the in-core series-parallel diode network, results in substantially uniform emitter temperatures throughout the reactor. Novel analytical techniques for temperature-flattening a nonuniform reactor are described and used to generate specific illustrative designs. It is shown that, even with severe nonuniformities, the temperature-flattened reactor exhibits almost as high a power density and conversion efficiency as a reactor using fuel-zoning for full power flattening. By eliminating the need for fuel-zoning, the concept described here reduces the critical size and system weight, and permits the use of thicker emitter walls for enhanced reliability. (auth)

11961 (CONF-720613-P1, pp 189-208) OUT-OF-CORE THERMIONIC-CONVERTER SYSTEM FOR NUCLEAR SPACE POWER. Breitwiesser, R. (Lewis Research Center, Cleveland). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Designs of nuclear thermionic space power systems with the converter outside the reactor were re-examined in the perspective of recent advances in heat-transfer methods, materials, converter performance, and radiator design. The 40- to 70-kW(e) power range is treated. The configuration meets the constraints of readily available launch vehicles, allows for off-design operation including startup, shutdown, and possible emergency conditions, provides tolerance of failure by extensive use of modular redundant elements, incorporates and uses heat pipes in a fashion that reduces the need for extensive in-pile testing of system components, and uses thermionic converters, nuclear fuel elements, and heat-transfer devices in a geometrical form adapted from existing in-core thermionic system designs. This approach contributes to a cohesive research and development program for in- and out-of-core thermionic systems at a broad range of powers. Designs and in some cases performance data for elements and groups of the elements of the system are included. These elements are novel heat-pipes that extract heat from the reactor and form part of a modular cross flow heat exchanger, long heat pipes that provide electrical isolation of the individual thermionic converters, and thermionic converters that include space radiators that then compose a converter-radiator module. As a part of the presentation of the design and performance, benefits of the highly modular system approach to reliability, safety, economy of development, and flexibility are discussed. (auth)

11962 (CONF-720613-P1, pp 209-221) COMPLETELY MODULAR THERMIONIC REACTOR ION PROPULSION SYSTEM (TRIPS). Peelgren, M. L.; Kikin, G. M.; Sawyer, C. D. (Jet Propulsion Lab., Pasadena, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The nuclear reactor-powered ion propulsion system described is an advanced completely modularized system which lends itself to development of prototype and/or flight type components without the need for complete system tests until late in the development program. This modularity is achieved in all of the subsystems and components of the electric propulsion system including the thermionic fuel elements, the heat rejection subsystem (heat pipes), the power conditioning modules, and the ion thrusters. Both flashlight and external fuel type in-core thermionic reactors are considered as the power source. The thermionic fuel elements would be useful over a range of reactor power levels. Electrical heated acceptance testing in their flight configuration is possible for the external fuel case. Nuclear heated testing by sampling methods could be used for acceptance testing of flashlight fuel elements. The use of heat pipes for cooling the collectors and as a means of heat transport to the radiator allows early prototype or flight configuration testing of a small module of the heat rejection subsystem as opposed to full scale liquid metal pumps and radiators in a large vacuum chamber. The power conditioner (p/c) is arranged in modules with passive cooling which allows complete prototype testing. The ion engines are typically matched with one or more p/c modules and are the same size for any power level propulsion system of interest. (auth)

11963 (CONF-720613-P1, pp 223-233) MEASUREMENTS WITH THERMIONIC FUEL ELEMENTS IN THE ITR CRITICAL FACILITY. Krings, F. J.; Kirch, N.; Bloser, M.; Ramakrishna, D. V. S. (Kernforschungsanlage, Jülich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The critical facility ITR is described and measurements of reactor physical parameters are reported. Critical masses of different core-configurations and reactivity effects are discussed. The feasibility of dynamic methods is presented. By means of reaction rates the spectral peculiarities of ITR are shown. Representation of power distributions is given. (auth)

11964 (CONF-720613-P1, pp 235-249) SIGNIFICANCE OF THE RESULTS OF THE ITR CRITICAL EXPERIMENTS FOR THE CALCULATION OF AN INCORE THERMIONIC REACTOR. McLaughlin, T. P.; Schmitz, D.; Simon, D. (INTERATOM, Bensberg, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

As the goals, physical layout, fuel element requirements, and materials selection for an ITR differ significantly from other reactor types, testing of ITR critical configurations has been proceeding since the Summer of 1971. Results of these critical experiments will be important for the nuclear calculations relative to a proposed ITR prototype. These measurements which are being performed at room temperature are yielding results concerning criticality, reactivity worths and kinetic parameters. With these it is possible to decide which calculational methods are necessary in order to achieve sufficient accuracy in future ITR designs. Zero- and one- dimensional cell calculations were employed for the determination of fast and thermal group constants respectively; the former calculations included a rigorous geometry-dependent resonance absorption treatment. Criticality calculations were performed with both two dimensional S_N and three dimensional Monte Carlo programs. Agreement between experiment and theory was generally better than ±1.5% with both codes when scattering in H and Be was handled with a linearly anisotropic (P_1) approximation. The reactivity worths of driver rods and structural materials have also been measured and calculated. For reactivity changes of less than a few dollars reproducibility was good. Rossi-α calculations yielded results which generally agreed with pulse and noise analysis measurements within the experimental uncertainties of about ±3% and which in all cases deviated less than ±7% from the measured values. These prompt decay constants, coupled with calculated B_{eff} values, enabled evaluations of the prompt neutron lifetimes of the systems. Areas in which the experiments to date have aided in indicating the necessity of refined calculational techniques have been: anisotropic scattering effects both in core and reflector regions; epithermal and fast group-structure; generation of the thermal scattering matrix in beryllium; the influence of the fueled zone neutron spectrum on the n, 2n production in the beryllium reflector; and impurities in both core and reflector elements. (auth)

11965 (CONF-720613-P1, pp 251-262) SOME NUCLEAR CALCULATIONS AND THEORETICAL INTERPRETATIONS OF THE CRITICAL EXPERIMENT ITR. Bernnat, W.; Dagbjartsson, S.; Schmidt, F. A. R.; Talarek, H. (Kernforschungsanlage, Juelich, Ger.). 1972.

From third international conference on thermionic electrical power generation; Jülelich, Federal Republic of Germany (5 Jun 1972).

Theoretical considerations and initial computational results in analyzing the experimental data of the ITR critical experiment are presented. The neutron cross sections source and their transformation into group cross sections necessary for the reactor calculations which were carried out mainly with Monte Carlo and two dimensional S_N-codes are discussed. The results of three different kinds of computations are presented. These are critical mass determination, activation integral calculations and reactivity worth calculations of reflector parts. Different nuclear data sets showed a surprisingly high difference in the calculated critical mass. With the nuclear data from the ENDF/B-I library, a good agreement between the calculated critical mass (Monte Carlo method) and the measured values was obtained. Also other computational results showed a satisfying agreement with the experiment. (auth)

11966 (CONF-720613-P1, pp 263-276) NEUTRON STUDIES FOR THE FRENCH THERMOELECTRONIC PROGRAM. Nobile, M.; Del Negro, R.; Jacquemart, R.; Schwartz, J. P. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The French thermionic program has in view the development of a reactor immersed at the bottom of the sea. Neutron studies are a significant part of the basic experimental and theoretical work required to verify the basic data and to refine methods of calculation. The basic irradiation program for a two-zone core and the theoretical developments are described. The DIOGENE program is discussed, primarily with respect to the adaptations required in the Triton II to carry out the irradiation program of the JOB 01 generator. The temperature coefficent for a two-zone core and the reactivity effect of the W thickness of the emitter were measured in reactor studies. (JSR)

11967 (CONF-720613-P1, pp 295-305) DYNAMICS AND CONTROL OF AN INCORE THERMIONIC REACTOR IN THE POWER REGION. Rex, D.; Weber, M. (Technical Univ., Brunswick). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A study was performed to investigate the power and temperature transients of incore thermionic reactors with driver rods after reactivity perturbations and changes in power and power demand and to develop a simple control system. Both a terrestrial test reactor ITR and a space system were investigated. Measured and calculated data on the heat flow characteristics of thermionic emitters were used in the mathematical models for describing the dynamics of controlled and uncontrolled reactors. It was concluded that the dynamic behavior of an incore thermionic reactor proved to be inherently stable for both the terrestrial and space versions investigated. The response to step disturbances depends considerably on the properties of the thermionic cells and on their operation. The thermionic reactor power does not adjust automatically to the electrical power demand, so a control system is necessary. A simple and safe control system can be applied for power transients in both reactor versions. The flight version was found to respond more sensitively to power changes and disturbances. (LCL)

11968 (CONF-720613-P1, pp 323-335) VOLTAGE-CONVERSION FOR INCORE THERMIONIC REACTORS. Kleinkauf, W.; Rasch, W. (DFVLR, Brunswick). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A power conditioning system for space-used thermionic reactors is described. The use of thermionic-generators depends largely on the power-conditioning, which is necessary to connect the generator to the load. Among others the generation of energy by an incore-thermionic-reactor is characterized by radioactivity in its surrounding, by high output currents at low output voltages, by a load-dependent generator characteristic, by several separated voltage sources, by a current dependent emitter temperature, and by the possibility of short circuit of some diodes. A transistorized poly-phased inverter with by-pass considers all these peculiarities. The by-pass system fixes a desired operation point on the generator characteristic. The inverter attends to a constant output voltage if the input voltage or the load varies. The regulation of the sinusoidal output voltage is achieved by pulse width variation. The optimal inverter frequency was chosen to meet the minimum weight requirements for the total energy supply system. (auth)

11969 (CONF-720613-P1, pp 337-348) SWITCH PROPERTIES OF THERMIONIC DIODES WITH CESIUM VAPOR. Pachur, N.; Kleinkauf, W.; Rasch, W. (DFVLR, Brunswick). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Under certain conditions thermionic diodes show current-voltage characteristics similar to those of thyristors. Therefore, it may be possible to use these diodes as switching elements in a DC-AC converter. Great advantages can be expected from using thermionic switching elements for thermionic reactor systems, specifically, weight savings in nuclear space power systems since the thermionic switching elements would not require shielding nor an additional cooling system. First studies with a cesium diode with cylindrical electrodes and a cesium diode with plane electrodes have shown that such diodes are usable as high current switches. They have usable switch properties such as breakdown voltage $U_B \approx 3$ V, forward voltage $U_F \approx 0.5$ V with forward current density $J_{EC} \approx 8$ A/cm^2 at diode parameters which are very different from those applied to energy generating diodes. A good emitter temperature is about $T_E = 1000$°C, the electrode distance is near $d = 1$ mm, and the cesium vapor pressure near $P_R = 0.1$ Torr. Exact specifications of the favorable electrode materials or electrode geometry and of the dynamic behavior during switching can be made after more intensive investigations. (auth)

11970 (CONF-720613-P1, pp 349-364) CONTROLLED dc TO dc CONVERTER FOR A SPACE-QUALIFIED THERMIONIC REACTOR. Uhing, E. (Ruhr-Univ., Bochum, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

First results are described of an investigation which relates to the development of a space-qualified Incore-Thermionic-Reactor. It concerns the handling of the power produced by the thermionic reactor to supply a television satellite. To begin with, a general design concept of the handling of power is submitted. Accordingly all primary converters are working in parallel on a common d.c. bus bar with a controlled voltage, the load with the highest power consumption directly connected to it. The control

strategy considers that fast processes, such as the sudden reduction of load currents, will be compensated by the primary converters; slow or predictable processes, for example intervals in transmission, by the relatively slow reactor control. The voltages for the remaining loads are obtained from the a.c. intermediate circuit of the primary converter, using controlled secondary converters at high demands to the voltage stabilization only. Therefore the investigations concentrate to the development of suitable circuit arrangements for a primary converter, which provides voltage stabilization at load swings as well as at alterations of the generator voltage. These and several further demands, which follow based on the special power source and the particular field of application, are listed in detail. Hence two circuit arrangements are described, which both base on the principle of the push-pull d.c. converter. The outstanding characteristic of the first circuit is its especially low number of components. It is marked by the fact that it shifts the operating point of the generator towards increasing currents in case of partial-load region at the output of the converter. The generator is short-circuited, if there is no-load operation at the output of the converter. The second circuit differs from the first one because of the application of an electrical bypass, switched on and off periodically by means of semiconductor circuit elements. With these additional components one can get several improvements. Among other things the generator current remains constant at every operating condition. For both circuit arrangements the power rating of the most important components is compared. (auth)

11971 (CONF-720613-P1, pp 381-397) FRENCH PROGRAM FOR THE DEVELOPMENT OF A THERMOELECTRONIC NUCLEAR REACTOR. Devin, B. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The French program is oriented toward a reactor for undersea use. The program consists of basic studies, technical studies, the DIOGENE program, and reactor studies. The DIOGENE program and its purpose are outlined. Reactor studies have centered on critical experiments, development of calculation tools for the analysis of these critical experiments, and measurement of the temperature coefficient. The limitations placed on the reactor by the functioning of the reactor and by its placement at the bottom of the sea are discussed. The insertion of the reactor in its environment is considered. (JSR)

11972 (CONF-720613-P1, pp 399-427) STATUS REPORT ON REACTOR DEVELOPMENT ACTIVITIES IN THE FRG. Pruschek, R. (INTERATOM, Bensberg, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The history, origins, goals, and milestones of the program in West Germany for developing an incore thermionic reactor (ITR) are reviewed, the moderated, liquid metal-cooled thermionic reactor chosen for development, its components, and the ITR test facilities are described, and the current state of ITR technology is discussed. (LCL)

11973 (CONF-720613-P1, pp 429-441) UNITED STATES THERMIONIC REACTOR PROGRAM. Beard, D. S. (Space Nuclear Systems Office, Washington, DC). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

An overall summary of the U.S. Thermionic Reactor Program is presented. Significant events since the 1968 Second International Conference on Thermionic Electrical Power Generation are highlighted and the development approach is discussed. (auth)

11974 (CONF-720613-P1, pp 443-464) THERMIONIC ELECTRICAL POWER GENERATION. (Panel Discussion). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Programs and plans in the Federal Republic of Germany, France, USA, and USSR for developing and using thermionic electric power plants are discussed by a panel of thermionic experts. Undersea and space applications are emphasized. (LCL)

11975 (CONF-720613-P2, pp 479-489) THERMIONIC FUEL ELEMENT TESTING AT GULF GENERAL ATOMIC. Yates, M. K.; Fitzpatrick, G. O.; Schwarzer, D. E. (Gulf General Atomic Co., San Diego, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Nine thermionic fuel elements (TFEs) were tested in the GGA Thermionic Test Reactor (TITR). Three of these were full-length (6 cell) TFEs, which are the prototypes for the reactor experiment. All three are still on test; 6F1 has been on test for more than 5000 h; 6F2 has accumulated over 3700 h of operation; and 6F3 has accumulated over 1100 h of operation. The other six TFEs are partial length (one and two cell) TFEs. Four of these remain on test. The longest test lasted 12535 h. Three of the others have operated for from 4000 to 5000 h and remain on test. (auth)

11976 (CONF-720613-P2, pp 491-500) MULTICELL THERMIONIC FUEL ELEMENT FABRICATION TECHNOLOGY. Horner, M. H.; Grebetz, J. C.; Kay, J. Jr. (Gulf General Atomic Co., San Diego, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The technology used in fabrication of multicell, series-connected thermionic fuel elements (TFE's) is described. One series of TFE's contained two converters and incorporated 16.51 mm O.D. emitters that were 51 mm long. The second series, called F series, design is fabricated in one, two, and six converter modules; the six converter design being prototypic of fuel elements for a thermionic reactor experiment and for space power applications. F series designs incorporate emitters that are 27.94 mm O.D. and 51 mm long. F series cells are fabricated by welding an insulator-seal, a fueled emitter subassembly and a trilayer together. Six F series cells are welded in series, and to an electric lead and cesium reservoir to form a TFE. The TFE is encased in a continuous sheath tube that is bonded to the trilayers of the cells. Separated cesium and fission product volumes are formed during the fabrication procedure. Thirty F series cells have been fabricated and incorporated into TFE's. (auth)

11977 (CONF-720613-P2, pp 519-533) SYNTHESIS OF TESTS AND POST-MORTEM EXAMINATIONS FOR CONVERTERS IRRADIATED BETWEEN 200 AND 5000 HOURS. Lebourg, R.; Bliaux, J.; Clemot, M.; Marquer, R. (CEN, Saclay, France). 1972. (In French).

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Post-mortem examinations of 8 converters irradiated since 1967 are described. The mechanical and electrical characteristics of these converters are briefly reviewed and lifetime failures and observed degradations are discussed. After a deactivation delay of four to six weeks, the irradiation capsule was disconnected from its support. Neutron radiography was used to detect a water leak. In a hot cell, the capsule is opened and the converter laid bare. The fuel repartition inside the emitter was determined by x radiography and γ scanning. Fission gases were recovered using a special pump. Leaks which would have developed during the in-pile test were checked for. After disassembling the converter, metrology and micrography examinations were made. The results of these examinations are presented. (auth)

11978 (CONF-720613-P2, pp 535-553) DESIGN AND CONSTRUCTION OF 100 W(e) AND 300 W(e) MODULES AND 1 kWe THERMIONIC FUEL ELEMENTS. Shroff, A. M. (Thomson-CSF, Paris); Lalaurie, J.; Molnar, F.; Durand, J. P.; Marquer, R. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Procedures for fabricating 100 kW(e) and 300 kW(e) thermionic converters for laboratory tests and for experiments on thermionic fuel elements are summarized. The technical problems encountered are described. Some test results are reported. (LCL)

11979 (CONF-720613-P2, pp 555-568) IRRADIATION TESTS WITH ITR EMITTERS. Eichhorn, O. (Siemens AG, Erlangen, Ger.); Huebner, H.; Neffe, G.; Wolfrum, K. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Within the scope of the in-core thermionic reactor (ITR) development program, emitters are being irradiation tested in the KARLSRUHE FR 2 research reactor. These tests aim at confirming the emitter design, under realistic thermionic converter operating conditions and at determining the performance of the fuel, the fission gas venting system and the thermionic emission layer. An irradiation capsule for two emitters was developed. The emitters are operated at 200% design heat rating, i.e. at a power density of 100 W/cm^2 on their surface, in order to reduce the duration of the in-pile tests. Cooling is by radiation and through a helium-filled gas annulus. High-temperature thermo-

couples are employed for temperature measurements. The emitter temperatures can be automatically controlled within certain limits by means of additional electric heaters. The first emitter version to be tested contained vented UO_2 pellets inserted in the ten boreholes of the cylindric molybdenum body. At first, a short-term irradiation test was performed to evaluate the performance of the irradiation capsule and the measuring equipment. For 35 h a temperature of 1860°C was maintained in the centre of the emitters. Post-irradiation investigations concentrated on dimensional deviations and metallographic examinations. Measurements of the emitter surface disclosed reductions in diameter of up to 25 μm, accompanied by a circumferential waviness with the minima and pellet bores coinciding. Axial and radial metallographic microsections were examined for functional integrity of the venting system and for evidence of fuel migration and evaporation in radial direction. The results of these examinations are presented and interpreted. The first long-term test with the capsule described above was started in April 1971 and continues at a thermal output of 4500 W per emitter and a surface power density of 100 W/cm^2. For the first 1000 h after starting the test, the emitter centre temperatures were at the design value of 1800°C, thereafter they dropped to roughly 1500°C with the output remaining constant. An increase in diameter due to swelling can already be deduced from this observation since a reduction in the gas annulus size enhances the cooling performance. On March 31, 1972, the long-term irradiation test had a total irradiation time of 6150 h and a burn-up of 28,000 MWd/tU, or 3.3 at.% of uranium. (auth)

11980 (CONF-720613-P2, pp 569-580) STATE OF DEVELOPMENT OF DIODES FOR INCORE THERMIONIC FUEL ELEMENTS. Haar, W.; Holick, H.; Jester, A.; Minor, A. (Brown, Boveri and Cie AG, Mannheim, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Thermionic fuel element development carried out within the German ITR-project is described. Performance characteristics of the following cylindrical out-of-pile diodes are discussed: a molybdenum electrode diode operating at an average temperature of 1920°K (as of March, 1972 this diode had attained a lifetime of 27,000 h and continues on test. Over the operating period the power output decreased by about 15%.); a UO_2-powder fueled molybdenum emitter diode which showed a pronounced oxygen effect during the first 600 h, stabilizing to a constant performance for more than 20,000 h; a UO_2-pellet fueled molybdenum emitter diode which also showed a strong oxygen effect during the first 1500 h; and two diodes with preferentially 100- and 110-oriented tungsten-coated molybdenum emitters. Output power densities of these diodes are compared to two diodes with polycrystalline molybdenum emitters for emitter and collector temperatures of 1900°K and 870°K respectively, a current density of 10 A/cm^2, 0.15 mm spacing and optimum cesium reservoir temperature. In these out-of-pile tests and also in initial in-pile tests the emitter centering system and metal ceramic seal worked reliably. (auth)

11981 (CONF-720613-P2, pp 581-592) IRRADIATION EXPERIMENT WITH A TRIPLE THERMIONIC DIODE. Haar, W. (Brown, Boveri and Cie AG, Mannheim, Ger.); Holick, H.; Jester, A.; Krapf, R.; Herion, J. 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

The first experiment with three ITR cells in series is described. The emitters of the diodes are arc cast molybdenum in the revolver configuration with 20 mm diameter and 54 mm length, fueled with 95% dense and 20% enriched uranium dioxide pellets in ten bore holes of 3.5 mm diameter. In this experiment the waste heat at the trilayer system is rejected by heat conduction across a helium gap to a surrounding cooling system and finally to the reactor water. Each collector has three axial holes of about 1 mm diameter for venting the gaseous fission products from the emitter of each diode to a common fission gas trap containing active charcoal located at the top of the triple diode. Cesium vapor and fission gases are separated from each other by vacuum-tight metal-ceramic-seals on top of each diode. The irradiation experiment was carried out in the Merlin reactor at the KFA Jülich. The neutron flux density in the diodes was varied by moving the irradiation rig radially toward or away from the edge of the reactor core. A brief description of component testing prior to assembly, assembling and processing of the triple diode, and performance during irradiation in the reactor is given. (auth)

11982 (CONF-720613-P2, pp 681-691) CERAMIC-TO-METAL SEAL DEVELOPMENT FOR THERMIONIC FUEL ELEMENTS. Chin, J., Messick, C. W. (Gulf General Atomic Co., San Diego, CA). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

High temperature ceramic-to-metal seals have been developed for application in thermionic fuel elements. The high temperature ceramic-to-metal seal is fabricated by brazing niobium skirts to an alumina (Lucalox) ceramic with a vanadium–niobium braze alloy. It has been qualified at 1473°K. Results of thermal stability, thermal shock and mechanical testing of these seals are presented. (auth)

11983 (CONF-720613-P2, pp 1001-1013) EMITTER FUEL SYSTEM FOR A THERMIONIC FUEL ELEMENT. Gregorius, K.; Janner, K.; Krause, E. D.; Peehs, M.; Schoeneich, H. (Siemens AG, Erlangen, Ger.). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

A W-tube-emitter with UO_2 as fuel is described. The emitter is designed for a hard n-spectrum (ITRE). The series connection and multi-layer collector systems of the in-core thermionic reactors, (ITR) were retained. For computation of the UO_2 and T distribution, computer program TEUV 3G was compiled and can be applied to any required emitter geometry. The temperature distribution on the active converter face and on the rear end wall is adequately flattened. It is expected that the emitter will have only a low swelling effect. Rapid load increases must be avoided. (auth)

11984 (GA-9595) THERMIONIC EMITTER DIMENSIONAL STABILITY ANALYSIS. Gietzen, A. J. (Gulf General Atomic Co., San Diego, Calif. (USA)). 30 Apr 1971. Contract AT(04-3)-167. 89p. Dep. NTIS $6.50.

Declassified 5 Jun 1973.

Thermal analysis, elastic stress analysis, and viscoelastic stress analysis have been done on UO_2 fueled emitters to evaluate potential deformation mechanisms. Analysis was done on an in-pile test to explain observed deformation and on a prototype design to predict long term behavior. Evaluation of the in-pile test converter designs focused on emitter temperature distribution and the resulting thermal stresses, the effect of fission density profiles, and the effects of internal gas pressure. Finite element viscoelastic analysis was applied to the emitter of a specific in-pile test (GGA Mark VIIB, C-1) to determine effects of thermal cycling and gas pressure with the emitter. The results are compared to observed phenomena. The analysis of the prototype emitter design was done to determine the effects of small thermal cycles with fuel redeposition, and fuel swelling. The results show that repeated temperature cycles as small as 50°K can produce significant deformation if the time at the lower temperature of the cycle is sufficient to allow fuel redeposition and the time at the higher temperature is sufficient for stress relaxation. Deformations due to fuel swelling are predicted to be sufficiently low as not to have serious effects. The effect of fuel swelling rate and the dependence on emitter temperature are also evaluated. The basis for the finite element viscoelastic method is summarized along with the analytical formulations for the creep (including primary creep) and relaxation behavior of tungsten. (22 references) (auth)

11985 (GA-11004) POST-OPERATIONAL EXAMINATIONS OF TWO CARBIDE-FUELED IN-PILE CONVERTERS. Yang, L.; Horner, M. H.; Cochran, F. L. (Gulf General Atomic Co., San Diego, Calif. (USA)). 30 Sep 1970. Contract AT(04-3)-167. 67p. Dep. NTIS $5.50.

Declassified 5 Jun 1973.

Two 90UC–10ZrC fueled converters, IC-I3 of Mark VI configuration and IC-C3 of Mark VIIB configuration, were examined in hot cell after in-pile operation. IC-I3 operated for 4395 hours at an average emitter temperature of 1675°C as a converter test and then for 2948 hours at an average emitter temperature of ~1500°C as a fuel irradiation test; the average fuel burnup achieved was 2.5×10^{20} fission/c.c. IC-C3 operated 5445 hours at an average emitter temperature of 1670°C as a converter test; the average fuel burnup achieved was 5×10^{19} fission/c.c. The carbide fuel contained 4 wt % tungsten and had a C/U atom ratio of 1.05. Other unique features for the converter components were fluoride tungsten claddings of controlled fluorine contents (18 ppM for IC-I3 and 19 ppM for IC-C3), and the presence of a high temperature seal and a graphite sorption cesium reservoir in IC-C3 converter. The results obtained on fuel swelling, emitter deformation, fuel-cladding interaction and microstructures of various converter components are presented. Solutions to the problem areas encountered are recommended. (auth)

11986 (GKSS-73-E-20) DETERMINATION METHOD FOR THE OPTIMIZATION OF NUCLEAR AND CONVENTIONAL CONTAINER SHIP FLEETS. Pihowicz, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1973. 62p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

The method described permits the optimization of a container ship fleet on the basis of a deterministic model. This means, the determination of the optimal speed and cargo capacity of the ship, as well as the optimal parameters of the development in time of a fleet in the optimization period. The initial size of the fleet and the moment in which the number of ships is increased are used as parameters for the development in time of a container ship fleet. The optimal parameters for a container ship fleet are obtained when taking into consideration the following data: container service, specific costs, prices and all the parameters that determine the function obtained from statistical data. With these data it is possible to compare conventional and nuclear propulsion of container ships. (GE)

11987 (N-73-18679) EFFECTS OF BACKLASH AND DEAD BAND ON TEMPERATURE CONTROL OF THE PRIMARY LOOP OF A CONCEPTUAL NUCLEAR BRAYTON SPACE POWER PLANT. Petrick, E. J. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1973. 23p. (NASA-TM-X-2754). NTIS.

An analytical study was made of the stability of a closed-loop liquid-lithium temperature control of the primary loop of a conceptual nuclear Brayton space powerplant. The operating point was varied from 20 to 120 percent of design. A describing-function technique was used to evaluate the effects of temperature dead band and control coupling backlash. From the system investigation, it was predicted that a limit cycle will not exist with a temperature dead band, but a limit cycle will not exist when backlash is present. The results compare favorably with a digital computer simulation. (auth)

11988 ECONOMETRIC STUDIES OF NUCLEAR REACTORS IN SPACE. Larabi, J. (Centre National d'Etudes Spatiales, Paris). Ind. At. Spatiales; 17: No. 1, 47-57(Jan 1973). (In French).

A technique was developed for the rationalization of decisions concerning nuclear reactors in space. Two limiting cases are considered: the first case in which the future may be expressed in terms of probabilities assumes that sufficient information is available, mathematical expectations being the criteria employed; the second case corresponds to a totally unknown future, the minima criteria being employed. The problem posed by nuclear reactors in space is intermediate between these two situations. Some information is available on the likelihood or non-likelihood of future events occurring, but very often insufficient information is available to express the fact in terms of probabilities. The future is partially uncertain. (FR)

11989 PERFORMANCE POTENTIAL OF THE COLLOID CORE REACTOR CONCEPT IN NEAR-EARTH APPLICATIONS. Meier, T. C. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH). J. Spacecraft Rockets; 10: No. 9, 571-575 (Sep 1973).

An Air Force research program has produced performance estimates for the colloid core nuclear reactor rocket engine concept. These values are parametrically varied to determine their individual influence on an advanced nuclear upper stage to the Space Transportation System. Pessimistic and optimistic performance of the concept is estimated. The concept is compared with other propulsion schemes on the basis of velocity capability (as an indication of performance) and the mass which must be initially boosted into orbit (as an indication of cost). Based upon the analysis, it is concluded that the concept warrants further consideration for development as a future operational system. (10 references) (auth)

11990 PROBLEMS ARISING FROM THE CIVIL LIABILITY REGULATIONS IN THE RECENT OTTO HAHN AGREEMENTS. Pelzer, N. (Univ., Goettingen, Ger.). Atomwirt., Atomtech.; 18: No. 10, 467-468(1973). (In German).

Civil liability regulations play an important part in the various agreements relating to the permission for the N. S. "Otto Hahn" to enter foreign harbors. In contrast to previous agreements, the treaties that have recently been concluded by the FRG and Argentina and Brazil do not contain provisions for a "legal channeling" of liability according to the Brussels Convention. This leads to uncertainties which might affect not only the crew of the ship but also the ships builders and even the subcontractors. (GE)

11991 VORTEX RING NUCLEAR REACTOR. Drawbaugh, D. W. (to Westinghouse Electric Corp.). US Patent 3,768,253. 30 Oct 1973. Filed date 13 May 1968. 6p.

A fluidized core nuclear reactor particularly adapted for use as a rocket engine is described. A gas or colloidal suspension of fissionable material is supplied to a chamber into which a light propellant gas is injected at selected flow rates and angles so as to form a rotating ring vortex of the fissionable material. In addition, a region of solid fissionable material may be employed with the gaseous fissionable material. When so employed, the solid fissionable material surrounds the fluid filled chamber and is separated therefrom by a "neutron gate", a moderator and thermal neutron absorber, the latter allowing thermal neutrons to pass only into the fluid filled cavity. The thermal peaking thereby produced in the fluidized region causes the light propellant gas to fluidized fuel ratio to be increased so that the light propellant gas can "suspend" the heavier fissionable material away from the wall and outlet of the cavity. The light propellant gas is heated by the fissioning material and exits from the cavity through a thrust producing nozzle. Flow directing means cause some divergence of the flow path of the propellant material adjacent to the mouth of the nozzle further enhancing suspension of the fissioning material. (Official Gazette)

Reactor Safety and Environmental Aspects

Refer also to abstracts 10125, 10144, 10160, 12135, and 12218.

11992 (ANCR-1115) BOILING WATER REACTOR-FULL LENGTH EMERGENCY CORE COOLING HEAT TRANSFER (BWR-FLECHT) TESTS PROJECT. Final Report on Atmospheric Pressure Stainless Steel Experiments. Griebe, R. W.; McConnell, J. W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1973. Contract AT(10-1)-1375. 203p. Dep. NTIS $7.60.

Stainless steel-clad bundle experiments at atmospheric pressure were conducted as a part of the Boiling Water Reactor – Full Length Emergency Cooling Heat Transfer (BWR-FLECHT) Tests Project. This project was coordinated by Aerojet Nuclear Company and performed by the General Electric Company for the Atomic Energy Commission as a part of the Water Reactor Safety Program. The BWR-FLECHT project was designed to investigate the thermal and hydraulic phenomena associated with the emergency core cooling (ECC) injection portion of a loss-of-coolant accident (LOCA) in a boiling water reactor (BWR). Twenty-three bottom flooding experiments, twenty-seven top spray experiments, and eight combined spraying and flooding experiments were performed on two rod bundles containing stainless steel-clad heaters as fuel pin simulators. The ranges of experimental conditions were the following. Bundle initial power ranged from 25 to 390 kW, flooding rates ranged from 0.63 to 6.05 in./sec, spray rates ranged from 1.0 to 5.0 gpm, and bundle initial maximum temperatures ranged from 320 to 2150°F. The major parameters and results of these tests are discussed, and comments are presented regarding the effect of variations in the parameters on the heat transfer coefficients and bundle thermal response. (auth)

11993 (ANL-8041) DEFORM-II: MATHEMATICAL ANALYSIS OF ELASTIC, VISCOUS, AND PLASTIC DEFORMATIONS OF A REACTOR FUEL PIN. Watanabe, A. (Argonne National Lab., Ill. (USA)). Aug 1973. Contract W-31-109-eng-38. 33p. Dep. NTIS $4.00.

The analytical basis of the computer program DEFORM-II for predicting the deformation and the ultimate failure of a fast-reactor fuel pin under accidental conditions is discussed. The analysis is based upon the quasi-static, generalized plane-strain approximation of both the fuel and cladding cylinders with the elastoviscoplastic material behavior. (auth)

11994 (CEA-CONF-2353) RELIABILITY OF A METHOD OF SAFETY ANALYSIS. Carnino, A.; Quenee, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 24p. (In French). (CONF-730217-4; SM-169/13). Dep. NTIS (U.S. Sales Only) $3.25.

From symposium on the principles and standards of reactor safety; Julich, F.R. Germany (5 Feb 1973).

The steps to be followed in the reliability analysis of the safety of a part of a reactor are shown. The evolution of the analysis is illustrated by an example concerning the Phenix fast neutron reactor. The steps to be followed involve the construction of logic diagrams of the reactor functioning, making clear the critical points, definition of accidents or incidents to be studied, examination of the material intervening in the development of the incident, optimization of the safety of the system, collection of data, and estimation of the reliability of the system for a given incident. The analysis shows the difficulties encountered in the calculation of the reliability of a protection system. (JSR)

11995 (CEA-CONF-2419) STUDY OF THE REACTIONS BETWEEN $(U,Pu)O_2$ FUEL AND SODIUM. Housseau, M.; Marin, J. F.; Anselin, F.; Dean, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd] 26p. (In French). (CONF-730726-7). Dep. NTIS (U. S. Sales Only) $3.50.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Results of studies made outside the reactor for the reaction between sodium and the mixed oxides $(U,Pu)O_2$ are presented. The different parameters (temperature, time, composition of the mixed oxide, presence of fission products, purity of the sodium, and mechanical interaction with the jacket) were varied so as to make more precise their role in the appearance and development of the reaction as well as the nature and some properties of the products formed. Observations made during a jacket rupture occurring in Rapsodie–Fortissimo are described. The behavior of the fuel and the migration of the constituents and of the fission products are reported. (tr-auth)

11996 (CONF-730942-(P2), pp vp Sect. E1/1) CHARACTERIZATION OF AN ENERGY SOURCE FOR MODELING HYPOTHETICAL CORE DISRUPTIVE ACCIDENTS IN LIQUID METAL FAST BREEDER REACTORS. Cagliostro, D. J. (Stanford Research Inst., Menlo Park, CA); Florence, A. L.; Abrahamson, G. R.; Nagumo, G. 1973.

From 2nd international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Model experiments on the response of liquid metal fast breeder reactors (LMFBRSs) to hypothetical core disruptive accidents (HCDAs) require an energy source that simulates the mechanical energy release for the expanding vaporized sodium coolant. Experiments that were carried out for measuring the expansion characteristics for an energy source are described. The results are significant in that they establish a dependable well-defined energy source and compare favorably with a theoretically predicted requirement. The source has been applied successfully in a separate program to scaled reactor models. The source consisted of a mixture of PETN (pentaerythritol tetranitrate) explosive powder and glass microballoons within a vented steel canister. The apparatus consisted of a vertical rigid cylinder sealed at the upper end where the canister was attached and a piston which may support a water layer. While the detonation products expanded against the water and piston, the gas pressure p(t) and the piston displacement x(t) were measured. Knowing the piston area and x(t), and accounting for the compressibility of the water, we calculated volume as a function of time V(t). Then from p(t) and V(t) we determined the p-V relationship for the gas. Integration of the $p-\Delta V$ measurements gave the gas work done on the piston. Thirty-two $^1/_{30}$-scale and twelve $^1/_{10}$-scale experiments (relative to the FTR) provided the p-V relationships at charge levels of 2, 4, 8, 14, and 16 g and of 216 and 378 g, respectively, and showed the effects of scaling, the presence of water, and the time scale of expansion. Code calculations of p-V for a constant energy expansion of the detonation products were compared with experiments. Finally, the measured $p-\Delta V$ relationships were compared with a theoretical prediction for a 150 MW-sec HCDA. 4 references. (auth)

11997 (CONF-730942-(P2), pp vp Sect. E1/4) REACTOR STRUCTURAL RESPONSE TO MOLTEN-FUEL-COOLANT INTERACTIONS. Bratis, J. C.; Marciniak, T. J. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In order to realistically determine the structural response of a Liquid Metal Fast Breeder Reactor to a Molten Fuel-Coolant Interaction (MFCI), an MFCI region was incorporated into the two-dimensional, hydrodynamic containment code, REXCO-H. In this way, it is possible to account for the two-dimensional hydrodynamic response, as well as for the effect of vessels and plates, upon the expansion process in the MFCI region. The MFCI model has been modified significantly in order to extend the usefulness of the code under a variety of conditions. The sodium equation of state has been improved using basic thermodynamic relations and recent data to incorporate temperature dependent properties. Heat transfer models available to describe the MFCI include not only a quasisteady-state model; but also the parametric model. Several cases have been studied in order to delineate the effect of various parameters on the peak pressure generated in the MFCI zones. These include effect of initial fuel and coolant temperatures, void fraction, amount of molten fuel and/or vessel wall compliance. The response of a typical reactor configuration is evaluated for a given set of initial conditions, with three different ways of determining the energy release, including (a) the thermodynamic approach, (b) determination of a p-v using a one-dimensional model, and (c) the present model. 11 references. (auth)

11998 (CONF-730942-(P2), pp vp Sect. E1/6) PRODUCTION OF A GASEOUS EXPLOSION TO SIMULATE THE THERMAL INTERACTION BETWEEN FUEL AND SODIUM COOLANT IN SUBASSEMBLIES OF A FAST REACTOR. Warren, G. R. (Atomic Weapons Research Establishment, Foulness, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

In the present state of our knowledge about fuel coolant thermal interactions it is not possible to reproduce at will the type of vapour explosion produced in such an event and to use it in model core experiments. Therefore to investigate the damage effects of vapour explosions by model experiment it is first necessary to devise some simulation of this type of explosion. A high explosive charge would be a convenient source but the pressure pulse produced is of microseconds duration whereas it has been calculated that in a vapour explosion the pressure may last for tens of milliseconds. Propellant explosives, when burnt under controlled conditions, can be made to reproduce almost any pressure-time history required. The method adopted consists in burning the propellant inside a thick walled tube which is strong enough to withstand the explosive pressures. The tube is held inside the incident sub-assembly in a full scale model. A number of vent holes in the tube wall allow the high pressure gaseous combustion products to pass out at choke sonic flow and pressurize the sub-assembly. The pressure achieved in the sub-assembly results from the combined effect of gas supplied from the vented tube against gas lost out of the top end of the sub-assembly. The rate of gas supply is dependent on the area of vent holes and the burning rate of the propellant. It is shown how the latter may be controlled by the geometry of the propellant grains. A simple mathematical model of the process is described and it is shown how this may be manipulated on an analogue computer to predict the propellant and vented tube geometry required for a variety of model investigations such as the British PFR and the German SNR.

11999 (CONF-730942-(P2), pp vp Sect. E1/7) EMPIRICAL STUDY OF THE EFFECTS OF A SIMULATED SODIUM COOLANT VAPOUR EXPLOSION IN A SUB-ASSEMBLY OF THE PFR CORE STRUCTURE. Denny, P. H.; Rees, N. J. M.; Warren, G. R. (Atomic Weapons Research Establishment, Foulness, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A full scale model of the PFR core, containing 61 sub-assemblies and control rod guide tubes, surrounded by concrete blocks to simulate the inertia of the remainder of the core, is described. The model was subjected to the damaging effects of a propellant explosion designed to stimulate the pressure-time pulse which is expected to be produced by a fuel-coolant thermal interaction vapour explosion. The propellant is burnt inside a strong walled tube with vent holes in the wall designed to deliver high pressure gaseous combustion products to the incident sub-assembly to produce the required pressure pulse. The results of this test are compared with earlier work in which similar models were tested with high explosive charges. Although such charges produce a pressure pulse which is very much shorter than the duration expected of a vapour explosion it is shown that there is little difference in the damage effects. 4 references. (auth)

12000 (CONF-730942-(P2), pp vp Sect. E2/1) ANALYSIS OF THE PRIMARY CONTAINMENT RESPONSE USING A HYDRODYNAMIC ELASTIC–PLASTIC COMPUTER CODE. Chang, Y. W.; Gvildys, J.; Fistedis, S. H. (Argonne National Lab., IL). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The dynamic response of the primary containment to a hypothetical core disruptive accident (HCDA) is determined from the basic equations of mass, momentum and energy, and the equations of state of the medium. These equations are first expressed in material coordinates and then set into finite-difference form and solved numerically on the computer. Propagation of pressure waves, loads imposed on different parts of the reactor components, and the resulting deformations are determined at every time step throughout the sequence of the calculation. A sample calculation is presented. The mathematical model is discussed, particularly in the areas of modeling of reactor internals. The computer results are presented in both the numerical and pictorial form. Of particular interest are the computer-generated reactor configurations at various times during the excursion. These configurations show the sequence of events which had taken place during the excursion. Also of interest is the partition of energy which is shown as a function of time. It shows how the core disruptive energy is transformed into other forms of energy. A proper understanding of the energy partition should enable reactor designers to produce better system and containment designs. 17 references. (auth)

12001 (CONF-730942-(P2), pp vp Sect. E2/5) CALCULATION OF THE DYNAMIC RESPONSE OF REACTOR CONTAINMENT SYSTEMS TO FULL CORE EXPLOSIONS. Cowler, M. S.; Hoskin, N. E.; Rowlinson, A. G. (Atomic Weapons Research Establishment, Aldermaston, Eng.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

ASTARTE, a comprehensive time-dependent two-dimensional Lagrangian hydrodynamic code, has been developed within the UKAEA to determine numerically the loadings and strains arising within the primary containment system following a high energy reactor excursion. To validate this approach an extensive analysis, using ASTARTE, has been made of model excursion experiments for a single tank pool-type reactor system. These experiments, contained in an overstrong tank partly filled with water, included both bare explosive charges confined within a simulated reactor structure. An extensive coverage of the system was achieved with pressure transducers located on the walls and cover the roof so that the complete history of the experiment could be followed. The investigation has been extended to examine the tests involving confined charges. The results obtained from this analysis are discussed. The effect of the confinement on the coolant flow is examined and, inter alia, an explanation is found for the rather surprising result that the impulse on the roof is increased when the explosive charge is confined within the reactor structure simulant. The relatively massive diagrid plate structure has a significant effect on the directional distribution of outward energy propagation and this is discussed. Considerable emphasis is placed on the necessity to define accurately the constitutive relations, determining the stress-strain behavior, of all components included in the simulated reactor system. The calculations on the model test geometry are extended by replacing the energy release from an explosive charge by a UO_2, vapour explosion resulting from a Bethe-Tait energy release. The differences and similarities between loadings produced by the two methods of energy release are discussed at some length. 15 references. (auth)

12002 (CONF-730942-(P2), pp vp Sect. E2/6) EXPERIMENTAL ANALYSIS OF VESSEL STRUCTURES FOR FAST REACTOR JOYO UNDER SHOCK LOADING. Ando, Y. (Tokyo Univ.); Kondo, S.; Dawaguchi, O.; Uchida, T. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The results of a series of tests using chemical high explosives and slow burning explosives to investigate the hydrodynamic and structural effects of an accidental load to $1/5$ and $1/10$ simple scaled models of Japan's experimental fast reactor JOYO are presented. Based on these tests, the strain energy distribution between the lower part of vessel and the upper part of vessel and/or the hold-down bolts has been studied. Semi-empirical rationale to correlate radial strain of vessel with explosive energy has been obtained based on not only this series of experiments but also experiments performed by other groups. The other approach now employed by many groups is to solve the basic dynamical equations of reactor system numerically. Based on the one-dimensional Newtonian models of various parts of reactor system, the code ARIAKE has been developed to extrapolate experimental results rationally. Simulation experiments have been analyzed by this code and the analyses showed encouraging results to predict mechanical consequences of accident in reactor systems. 9 references. (auth)

12003 (CONF-730942-(P2), pp vp Sect. E2/7) MECHANICAL EFFECTS OF FUEL-SODIUM INTERACTION ON TANK STRUCTURES OF THE SNR-300 DURING A HYPOTHETICAL POWER EXCURSION. Doerbecker, K. (INTERATOM, Bensberg, Ger.). 1973. (In German).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

During a hypothetical power excursion of a sodium-cooled breeder reactor the hot fuel possibly will heat up the liquid sodium by heat conduction and radiation and vaporize it. This vaporization and the moving of masses will lead to high pressures locally and generate pressure waves which accelerate the tank structures inducing strains and stresses in them. To calculate the pressure generation the code BNR was developed, while for the computation of the mechanical response of the tank structures the code ARES, similar to ANL's REXCO, was used. 8 references. (auth)

12004 (CONF-730942-(P2), pp vp Sect. E2/9) EXPERIMENTAL ANALYSIS ON P. E. C. REACTOR CONTAINMENT BY 1:10 MOCK-UPS WITH DIFFERENT CHEMICAL EXPLOSIVES. Cenerini, R.; Curioni, S.; Millioni, G.; Verzelletti, G. (Univ., Bologna). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The results of experiments on 1:10 mock-ups are presented concerning the response of the P. E. C. reactor vessel and plug subject to a dynamic load due to an accidental power excursion. In order to evaluate the influence on structures damage of detonation velocity and gas bubble volume, explosive tests have been carried out using different chemical explosives i.e.: plastit; semigel; and a mixture of semigel (1.8%) + $KClO_4$ (44.5%) + $BaNO_3$ (24.5%) + magnesium (29.2%). (auth)

12005 (CONF-730942-(P2), pp vp Sect. E4/5) NONLINEAR DYNAMIC RESPONSE OF FAST-REACTOR CORE SUBASSEMBLIES UNDER IMPULSIVE LOADING. Belytschko, T. (Univ. of Illinois, Chicago); Kennedy, J. M.; Marchertas, A. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Predicting the behavior of the hexagonal fuel assembly duct when subjected to internally generated pressures is a consideration in the safety analysis of the LMFBR. The analysis is complicated by many factors: the three-dimensional effects that arise because of the lack of axisymmetry, the interaction of the duct with the coolant and adjacent ducts, the need to treat nonlinearities of both material and geometric character, the difficulties of obtaining material properties, and uncertainties in the loading. Isolating the relative importance of each of these features with the simplest available models is described. 13 references. (auth)

12006 (CONF-730942-(P2), pp vp Sect. F2/2) EXPERIMENTS ON THE CONSEQUENCES OF BURSTING PRESSURE TUBES IN A SIMULATED POWER REACTOR ARRANGEMENT. Ross-Ross, P. A. (Chalk River Nuclear Labs., Ont.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The Canadian power reactors are of the pressure tube type. The pressure tube contains the fuel and coolant (pressurized heavy water or boiling light water), and hence is a pressure vessel. The rupture of a pressure tube is one of the highly unlikely accidents which has to be considered in the hazard analysis. The pressure tubes of zirconium alloys are not expected to rupture: should a tube be damaged in any way and a crack develop, the growing crack would penetrate the wall and leak pressurized coolant which would be detected in the gas annulus between pressure and calandria tubes. For safety evaluations, however, a pressure tube is assumed to fail with a rapid large discharge of coolant into the gas annulus so that the calandria tube would be subjected to high pressure. Tests conducted to determine if the bursting of a pressure tube could cause failure of the calandria tube in a simulated power reactor arrangement are described. It was found that the initial shock from the discharge of coolant through a gross defect in the pressure tube would not cause the calandria tube to fail. As the coolant discharges from the pressure tube, the pressure in the calandria tube due to the steam-water mixture rises and reaches a peak within the first half second after pressure tube rupture. Whether the calandria tube can contain the coolant or not is dependent on tube strength, and pressure buildup, which in turn is dependent on coolant conditions and the exhaust area from the annulus through the end-fitting and end-shield assemblies. The test results and analysis show that by increasing the exhaust area the designer can reduce the possibility of calandria tube rupture in the event of a pressure tube rupture, and hereby limit the damage in the reactor to just one fuel channel assembly. Burst strength of irradiated and unirradiated calandria tubes of Zircaloy-2 was determined by a separate series of tests which are also described. 9 references. (auth)

12007 (CONF-730942-(P2), pp vp 1p.) MODEL AND CONDITIONS FOR FRAGMENTATION DURING MOLTEN FUEL/COOLANT THERMAL INTERACTIONS. Caldarola, L.; Kastenberg, W. E. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12008 (CONF-730942-(P2), pp vp 1p.) NUMERICAL AND EXPERIMENTAL RESULTS CONCERNING THE DYNAMIC RESPONSE OF A LMFBR CONTAINMENT TO A PROMPT CRITICAL EXCURSION. Benuzzi, A.; Fasoli-Stella, P.; Holtbecker, H.; Verzeletti, G. (EURATOM, Ispra, Italy). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12009 (CONF-730942-(P2), pp vp 1p.) SAFETY EXPERIMENTS ON THE PRESSURE TUBE EXPLOSION ACCIDENT FOR THE CIRENE REACTOR. Famiglietti, M. (Centro Informazioni Studi Esperienze, Milan); Parmeggiani, A.; Possa, G.; Galbiati, L. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12010 (CONF-730942-(P2), pp vp 1p.) APPROXIMATE METHODS FOR ACCIDENT CONDITION ANALYSIS OF PWR PRIMARY COOLANT LOOP COMPONENTS. Raju, P. P.; Palusamy, S. (Westinghouse Electric Corp., Pittsburgh). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12011 (CONF-730942-(P2), pp vp 1p.) DETERMINATION OF MECHANICAL STATE EQUATIONS IN DYNAMICS, TAKING INTO ACCOUNT WAVE PROPAGATION. Albertini, C.; Montagnani, M. (EURATOM, Ispra, Italy). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12012 (CONF-730942-(P2), pp vp 1p.) DYNAMIC RESPONSE OF A FAST REACTOR CORE TO SIMULATED VAPOUR EXPLOSIONS. Gast, K.; Will, H. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12013 (FIND-50404-R1) FIND: NORTH ANNA POWER STATION, UNITS 3 AND 4. Asher, J. M. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Dec 1973. 30p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

12014 (INIS-mf-577) METHODS FOR THE MEASUREMENT OF THE RADIOACTIVE CONTAMINATION IN THE VICINITY OF A NUCLEAR SITE. Boulenger, R. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 25p. (In French). INIS.

The effluents from nuclear plants can result in the irradiation of the people living in the environment, through two main channels: the discharge of radioactive liquid effluents, released from laboratories and reactors into the surface water, rivers, etc., and the discharge of radioactive gases and aerosols emitted from the ventilating systems from the stacks to the atmosphere. The different methods used to survey the environment are described comparing the sensitivity of the measurements with the allowable levels for the neighbouring population. Some results of that survey are indicated. This example of the control of a nuclear site environment shows that the control of the nuclear power plants which are presently under construction in Belgium, will be perfectly feasible as far as the risks that those plants could create to the population are concerned. (INIS)

12015 (INIS-mf-578) ORGANISATION OF THE DISCHARGE CONTROL OF RADIOACTIVE EFFLUENTS AND SURVEILLANCE OF THE ENVIRONMENT OF NUCLEAR POWER PLANTS. Beau, P.; Chanudet, L. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 7p. (In French). INIS.

Fission products from fuel elements, together with activation products, can cause contamination of the reactor surroundings. Although everything is done to reduce radioactive waste production and dispersion to a minimum, it is at the operational stage that there must be very strict control so that the consequences of such dispersion in the environment may be as slight as possible. Gaseous effluents are continuously checked at the disposal apertures. Liquid effluent checks consist of measurements of total beta activity and tritium activity of a sample taken from the waste tank. Continuous measurement on waste enables the alarm to be given in the event of an accidental excess. Periodical radioanalyses enable a detailed balance to be made of the different radionuclides given off. In normal operation, environment measurements are not aimed at controlling disposal, but serve to prove that the levels of external irradiation or contamination have not increased. The monitoring program applies to external exposure, drinking water, aerosols and certain products of the alimentary chain. In the event of an accident, measurements taken with a specially equipped vehicle enable the necessary data to be collected quickly. (INIS)

12016 (INIS-mf-583) CONTROL OF RADIOACTIVE EFFLUENTS RELEASE AT THE NUCLEAR POWER PLANT. Mostert, P.; van der Hulst, P. J. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 56p. INIS.

The sources of radioactivity in nuclear power plants, the effluent production, the treatment of effluents and the amounts released to the environment, as well as the consequences of this are discussed for BWR, PWR, and sodium cooled breeder reactors, both for normal operation and for a hypothetical accident case. It is shown that even though the production and release mechanisms may differ considerably from one reactor type to the other, all can be fitted with radioactive waste treatment equipment that is capable of reducing the normal irradiation of the neighbouring population to one to two order of magnitude below the basic ICRP limits for this group. All three reactor types discussed are now equipped with systems that can effectively contain a major accident (design basis accident) in such a way that irradiation of the neighbouring population is still very low and compares favorably with doses allowable for professionally exposed individuals. (auth)

12017 (INIS-mf-852) SAFETY CRITERIA FOR OPERATING POWER REACTORS. Shirvaikar, V. V.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 15p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The safety criteria for reactors can conveniently be classified into two parts: (i) criteria dealing with occupational workers, (ii) criteria concerning general population and environment. The criteria for occupational workers have not changed in essence since 1958 when ICRP reduced the maximum permissible exposure to 100 mr/week or 3 R in 13 weeks or 5 R/year. In the only operating power station in India, i.e. at Tarapur, the experience is that the dosage is more during maintenance periods rather than operating periods. An upper limit of single shot dose of 1 R has been permitted on the responsibility of the reactor superintendent. The second type of criteria, which involve the environment, are also based, for primary guidance, on the maximum permissible annual dose to a public individual of 0.5 R/year. This total dose can be obtained primarily through waste discharges to atmosphere and from water body. The safety criteria are therefore primarily concerned with the discharge limits. There can be more than one nuclear installation at a site, or a future expansion may be planned. It is therefore necessary to apportion fractions of the limit of 0.5 R/yr to the two routes (air and water) and further apportion fractions of these routes to individual plants as their design or operating limits. This is possible only after an objective environmental study at the site. These studies cover the micrometeorological studies and the studies of the water-food-man route. The working limits can then be fixed after identifying the critical path of radionuclides. In this approach, it is also necessary to consider the reactor type as well as the site. The radiation safety experience has brought out certain aspects of safety of the workers and environment not involving radiation. (auth)

12018 (INIS-mf-855) ENGINEERED SAFEGUARDS OF TARAPUR ATOMIC POWER STATION. Tirupataiah, T. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The engineered safeguards provided at the Tarapur Atomic power station (TAPS), India, are described. The various changes made during the construction and commissioning of the station are reported. The criteria for the engineered safeguards put up by USAEC are mentioned. The performance of the system is discussed and improvements are suggested. (auth)

12019 (INIS-mf-858) NO BREAK POWER SUPPLY FOR NUCLEAR REACTORS. Narsinga Rao, S. N.; Muthu, M. A.; Venkataraman, K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Certain essential loads such as coolant pumps and instrumentation require no break power supply to avoid costly damage and from safety considerations. The necessity for the no break power supply is discussed. Design aspects of no break power supply system for 100 MW Thermal Research Reactor at the Bhabha Atomic Research Centre, Trombay are described. The system comprises diesel generators, stationary battery, and motor generator sets in addition to the public utility power supply. The system for the Rajasthan Atomic Power Project (RAPP) and improvements in the system for Madras Atomic Power Project (MAPP) are highlighted. (auth)

12020 (INIS-mf-860) MODIFIED VAPOUR SUPPRESSION SYSTEM FOR THE MADRAS ATOMIC POWER PROJECT. Mahadev Rao, K. V.; Bajaj, S. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A significant design change from Rajasthan Atomic Power Project to Madras Atomic Power Project is the system of vapor suppression used for post-accident safety in the reactor containment structures. An added feature is the incorporation of the double containment principle by providing a secondary rubble masonry wall around the prestressed concrete perimeter wall. The net result is a reduction in the overall leakage rate from the containment system to the environment by an order of magnitude. The suppression pool is located such that the reactor building stands divided into two accident based volumes whereby all the regions accessible during normal reactor operation do

not see high temperatures or pressure even under the worst postulated accident. The design criteria used for the containment system and other necessary modifications to incorporate the vapor suppression system in Madras Atomic Power Project are described. (auth)

12021 (INIS-mf-861) CONDENSATION OF STEAM FROM AIR MIXTURE IN MAPP-1 VAPOUR SUPPRESSION POOL. Kakodkar, A.; Mehra, V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A vapor suppression pool is incorporated in MAPP-1 to limit pressure built up in case of a maximum credible accident. Complete condensation of steam was assumed in theoretical calculations for estimating the pressure and temperature transients following an accident. This assumption was proved to be valid by experiments conducted at the engineering laboratory of the Reactor Engineering Division, Bhabha Atomic Research Centre. The details of these experiments are presented. Some observations concerning the homogeneity of the air-steam mixture and scope of further work have also been outlined. (auth)

12022 (INIS-mf-862) THEORETICAL DIAGNOSIS OF MAXIMUM CREDIBLE ACCIDENT AND ENERGY RELEASES IN PURNIMA. Garg, S. B. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A mathematical model of the meltdown accident in fast reactors is presented. The equations of state based on the principle of corresponding states, Van der Waal's gas equation, saturated vapor pressure, and the threshold energy models are briefly described and their limitations are pointed out. The equation of state for plutonium oxide fuel is set up and the energy release in the PURNIMA reactor is calculated as a function of reactivity insertion rate, initial power level. Doppler reactivity coefficient, prompt neutron lifetime, and spatial power distribution. (auth)

12023 (INIS-mf-863) MAJOR ACCIDENT ANALYSIS FOR PURNIMA REACTOR. Kapil, S. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

A major accident in PURNIMA Fast Reactor is considered which leads to prompt criticality and melting of the core. Reactivity insertion in form of a ramp is used as the initiating mechanism. A density and energy dependent equation of state permitting the fuel transition from two-phase state to one-phase state (as voids are filled during the course of the accident) is used. Hydrodynamic equations for material movement are used and the efficiency of conversion of fission energy to kinetic energy is calculated. (auth)

12024 (INIS-mf-864) SAFETY PROBLEMS IN FAST BREEDER REACTORS. Krishnan, L. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The approach to safety analysis of nuclear reactors has generally been to start with high conservatism owing to insufficient knowledge of the answers to the safety problems and to gradually progress to a more realistic evaluation fully supported by experimental safety studies. In particular, safety analyses of the first few fast reactors to be built were characterised by abundant caution. The increasingly important role assigned to sodium cooled fast breeder reactors to meet future energy needs has made safety research an essential part of the fast breeder program. The basic safety problem pertaining to sodium cooled fast breeder systems are identified and the results of the extensive safety investigations underway in the various countries are reviewed. (auth)

12025 (INIS-mf-865) AEROSOL STUDIES RELATING TO FAST REACTOR SAFETY. Kotrappa, P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Both major and minor accidents involving the release of aerosols of sodium are possible during the operations and maintenance of a fast reactor. These aerosols could be radioactive, involving not only the radioactive sodium, but also fission products, uranium, and plutonium. Consequences of such releases can be satisfactorily analyzed only after conducting simulated laboratory experiments. The work that has been done in various laboratories is reviewed with special stress on the unanswered problems. (auth)

12026 (KFK-1858) CONTRIBUTION TO THE MODELING OF SODIUM BOILING UNDER ACCIDENT CONDITIONS IN FAST BREEDER REACTORS. Wirtz, P. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorentwicklung). Oct 1973. 112p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

A theoretical model is developed which describes integral boiling of the coolant in sodium cooled fast reactors under characteristic failure conditions. Based on results achieved in non-steady state boiling experiments under conditions similar to those in a reactor and on theoretical considerations the model calculates the ejection of sodium from a fuel element and the subsequent boiling behavior. The flow pattern is characterized by the formation of one or a few individual bubbles in the early stage of boiling and is, therefore, comparable to a slug type flow. The assumption of uniform pressure within a bubble is dropped. Thus it is possible to describe an annular type flow which is generated if the boiling zone reaches a larger axial expansion and contacts areas of greatly differing temperatures. Taking into account the pressure drop within a bubble has a decisive influence upon the boiling event in a fuel element. For analyses of fuel pin cooling after boiling inception the condition of the liquid film remaining on the fuel pins after the ejection of sodium is calculated as function of time and position. A comparison between model calculations and experiments shows good agreement with respect to the ejection of sodium and the oscillatory behavior of the coolant flow in the later stages of boiling. The computer program BLOW 3 based on the theoretical model can be integrated into a code system for the overall accident analysis of sodium cooled fast reactors. The good simulation of the thermohydraulic behavior of a fuel element allows analyses of characteristic accidents and their detectability. Results are presented from boiling calculations for characteristic SNR coolant channels. (69 references) (auth)

12027 (MRR-82) FAILURE ANALYSIS OF REACTOR SAFETY SYSTEMS. Gieseler, H.; Quintus, L. (Technische Univ. Munich (F. R. Germany). Inst. fuer Mess- und Regelungstechnik). Oct 1970. 71p. (In German). INIS.

In this failure analysis the 4 possible failure rates of equipment (dangerous, nondangerous, self-signalling, and not-self-signalling) of 2 safety systems are experimentally investigated. The calculation of the 4 different failure rates of devices and systems can be made with no regard to repair. The different probabilities for short circuits and interruptions of components are taken into account. By means of these data it will be possible to calculate the probabilities for the various failures and to infer the probability of system failure. (INIS)

12028 (ORNL-4903, pp 172-174) EMERGENCY PLANNING FOR ACCIDENTAL RADIOACTIVITY RELEASES FROM A LICENSED NUCLEAR FACILITY. Chester, R. O.; Chester, C. V. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

A few topics which affect the handling of an accidental radioactivity release from a nuclear power plant are discussed, such as: time available to institute emergency procedures, chemical prophylaxis, improvised respiratory protection, and dose and deposition estimation. The intent is to provide practical suggestions to supplement existing emergency plans and procedures. Pre-incident and the first few hours post-incident are the times of interest. (MHR)

12029 (ORNL-NSIC-55(Vol.1)) DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS. Vol. I. Docket No. 50-3 through 50-295. Heddleson, F. A. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-Eng-26. 224p. Dep. NTIS $15.00.

Design data, safety features, and site characteristics are summarized for thirty-two commercial nuclear power plants in the United States. Six pages of data are presented for each plant consisting of Thermal-Hydraulic and Nuclear Factors, Containment Features, Emergency Core Cooling Systems, Site Features, Circulating Water System Data, and Miscellaneous Factors. An aerial perspective is also presented for each plant. Those covered in this volume are Indian Point No. 1, Docket Number 50-3, and all subsequent plants finishing with Zion, Docket Number 50-295. (auth)

12030 (WCAP-8185(Vol. 3)) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Core Report 17 × 17, Volume 3. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 30 Nov 1973. 370p.

The safety analysis for the Westinghouse PWR with 17 × 17 array fuel assemblies is presented. Information is presented under the following main headings: normal operation and operational transients; faults of moderate frequency; and infrequent faults. (DCC)

12031 (WCAP-8185(Vol.4)) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Core Report 17 × 17, Volume 4. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 30 Nov 1973. 411p.

The safety analysis and technical specifications for the Westinghouse PWR with 17 × 17 array fuel assemblies are presented. Information is presented under the following main headings: limiting faults; definitions for technical specifications; safety limits and limiting safety system settings; limiting conditions for operation; and surveillance requirements. (DCC)

12032 SAFETY FACTORS IN NUCLEAR POLICY. Kenward, M. New Sci.; 60: No. 873, 536-537(22 Nov 1973).

The demand for electricity is rising quickly and it is estimated that Britain will possibly need to build up to two nuclear power stations a year for the next six years. Argument is raging as to the type of reactor that should be built. There are five AGR stations being built at the moment but Britain will have no reliable operating experience of them for another three or four years. Thus the CEGB, if it wants more nuclear power stations, must look elsewhere for a proven system. The two systems that fill the bill are the light water cooled reactors (LWR) developed in the United States, and the Magnox, gas cooled reactors developed in the UK. Advantages and disadvantages in the choice of each are discussed. (UK)

12033 SPECIAL REQUIREMENTS IN THE TECHNIQUE OF BUILDING NUCLEAR POWER PLANTS. Zerna, W.; May, B.; Nowak, B.; Stangenberg, F. (Univ., Bochun, Ger.). pp 13-22 of VGB-bautagung Dortmund 1972. Essen; Vereinigung der Grosskraftwerksbetreiber eV (1972). (In German).

From VGB conference on construction technique in thermal power plants; Dortmund, Germany (27 Sep 1972).

In the building of nuclear power plants, there are direct and indirect different new types of problems which occur outside the framework of the usual problems found in power plants. Among these are the construction of very large cooling towers and above all the measures required to satisfy the increasingly high safety needs of nuclear reactors. In this contribution, some considerations and data have been given on these two topics. (GE)

12034 ENVIRONMENTAL RADIOACTIVITY AT KO-RI NUCLEAR POWER PLANT SITE DECEMBER 1970–NOVEMBER 1972. Yang, K. R.; Pak, C. K. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 3, 240-248(Sep 1973).

Environmental radioactivity was measured in the Ko-ri nuclear power plant site area. Gross beta measurements were performed on soil, water, pine needle, and fallout samples collected during the period of December 1970 to November 1972. Radioactivities of ^{90}Sr and ^{137}Cs were measured by radiochemical analyses on samples of vegetables and marine products collected in 1972. Apparent seasonal variations and overall decrease by the year was also observed from the results of soil, pine needle, and fallout sample measurements respectively. (auth)

12035 NUCLEAR ENERGY AND SPACE ARRANGEMENTS. Haefele, W. (Kernforschungszentrum, Karlsruhe, Ger.); Goeb, R.; Mandel, H.; Munzinger, W.; Sahl, W.; Schaefer, H. Bild Wiss.; 10: No. 7, 795-802(1973). (In German).

The question of determining the place for nuclear energy plants was dealt with. Important aspects of the thermal load due to cooling equipment and its effects on the environment are discussed. The public energy politics and the society's awareness of the environment are also dealt with. (GE)

12036 SAFETY FOR THE PERSONNEL AND THE POPULATION IN THE OPERATION OF NUCLEAR POWER PLANTS. 2. Kley, H. (Brown, Boveri und Cie AG, Mannheim, Ger.). Sicherheitsingerieur; 2: No. 2, 23-29(1971). (In German).

The setup of the primary systems (e.g., pressure vessels, containment, protection system) of commercially available reactors of the AGR type (Hartelpool), BWR type (Muehleberg), and PWR type (Beznau) are considered in detail. (GE)

12037 TASKS AND ALTERNATIVES OF ENVIRONMENTAL MONITORING OF NUCLEAR INSTALLATIONS IN THE G.D.R. Roehnsch, W.; Ettenhuber, E. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Kernenergie; 16: No. 1, 20-23(Jan 1973). (In German).

In the German Democratic Republic the operator of a nuclear installation is responsible for environmental protection and liable to prove the protection quality with respect to environment by monitoring. Starting from this formulation of the tasks of environmental monitoring their fundamental possibilities of solution are discussed, and the concept of the system of environmental monitoring to be applied in the G.D.R. is explained. (auth)

12038 SAFETY ON INSTALLATION OF A REACTOR AT IKATA NUCLEAR POWER PLANT OF SHIKOKU ELECTRIC POWER CO. LTD. Genshiryoku Iinkai Geppo; 17: No. 11, 25-37(Nov 1972). (In Japanese).

The results of an investigation of safety factors concerning the nuclear installation at Ikata power plant by Shikoku Electric Co. Ltd. are discussed on the basis of the written application for permission of reactor installation in May 8, 1972. The investigation was based on the principle that the general public and employees should not be affected by irradiation either during ordinary operation or in case of emergency, and that the safety of the general public must be guaranteed even if an unexpected event might occur. Environmental conditions for installation, protection measures of reactor equipments in design, nuclear materials management, and exposure evaluation during ordinary operation (management of radioactive wastes, radiation management within building site and radiation protection outside power plant), safety countermeasures against various kinds of accidents, estimation of accidents (estimation of radiation exposure dose in accidents of primary coolant loss and damage of narrow tube of steam producer), and technical capacity were investigated. The investigation confirmed the safety of the reactor installation. (JA)

12039 DYNAMIC LOADINGS OF STRUCTURES IN NUCLEAR POWER PLANTS. Zerna, W. Konstr. Ing. Ber.; No. 13, 17-23 (1973). (In German).

The design and construction of nuclear power plants requires the consideration of unusual loads with little probability. Loads due to external explosions, aircraft accidents, and earthquakes are considered. Methods for their treatment are given with special consideration to their dynamic behavior. (GE)

12040 NUCLEAR ENERGY AND THE ENVIRONMENT IN ENEL'S ANNUAL REPORT. Com. Naz. Energ. Nucl., Notiz.; 19: No. 7, 29-31(Jul 1973). (In Italian).

On May 22, 1973, ENEL's President A. M. Angelini has presented to the press the Report on the Agency's 1972 year, discussing extensively the legislation concerning ENEL enacted in 1972; organization; personnel; new plants gone into operation; energy source supply and consumption in Italy; ENEL's power generation and exchanges; uses and sales of power; rural electrification; nuclear energy; scientific and technological research; electric power and the environment; power rates; economic and financial problems. The part concerning nuclear energy and the environment is presented here. (auth)

12041 BEHAVIOR OF SODIUM OXIDE AEROSOL IN A CLOSED CHAMBER. Kitani, S.; Matsui, H.; Uno, S.; Murata, M.; Takada, J. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 566-573(Sep 1973).

The behavior of sodium oxide aerosol in a closed chamber was studied for the safety analysis of a Na-cooled fast reactor. The experimental apparatus and techniques are first described. The aerosol was released during a short time by blowing air onto heated Na in a 1 m^3 chamber. The maximum mass concentration of the aerosol in the form of Na_2O ranged from 0.05 to 10 g/m^3. The particle size distribution, the aerosol mass concentration, and the mass deposition rates were measured as a function of time. It was found that the mass median diameter of the aerosol was related to the maximum mass concentration. To determine the character of the behavior of sodium oxide aerosol in the chamber, the density of the aerosol material and the thickness of the boundary layer through which the particles deposit on the chamber wall were observed. The initial half-time of the aerosol mass concentration was compared with the values numerically calculated under certain assumptions. (auth)

12042 NUCLEAR POWER. Patterson, W. Ecologist; 3: No. 7, 252-258(Jul 1973).

It is stated that apart from inevitable waste heat, nuclear power stations discharge significant amounts of low-level radioactivity which are dangerous, though how dangerous is controversial. It is further stated that there are two still more important disadvantages of nuclear power: the danger of reactor accidents, which are great enough to dissuade those experts in risk assessment, the insurance companies, from covering the nuclear industry against them; and the apparently insoluble problem of the disposal of high-level wastes. These problems are discussed. (UK)

12043 RESULTS FROM THE OPERATION OF A PROTOTYPE REACTOR SAFETY INFORMATION SYSTEM (RESI). Eglin, W.; Katz, F. W.; Krings, T.; Pee, A.; Schlechtendahl, E. G.; Schramm, K.; Schultheiss, G. F. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 18: No. 10, 469-471(1973). (In German).

In the Institute for Reactor Development of the Nuclear Research Centre, Karlsruhe, work has been carried out on the project Information System for Reactor Safety (RESI) which since 1972 comes

under the field of the Nuclear Safety Project. The work was coordinated with the IRS and supported by the UAED. Such an information system should, particularly in connection with the nuclear licensing procedure, help process the available information, make it easy to find and to enable a faster and more systematic handling for all institutions taking part. Besides a systems study on the possibilities and uses of a general information system for reactor safety, two prototype systems (RESI-1, RESI-2) were tested in order to obtain practical experience on how to go about with information systems in the field of nuclear licensing procedures. The prototype systems are reduced to small scale versions and, organized so as to basically be able to cope with the following tasks: 1) a reliable document file, 2) the elaboration of relevant queries with respect to reactor type and safety aspects (so-called type oriented query file), 3) the erection and answering of safety technical relevant questions concerning individual licensing cases (query data and output file). The system was thoroughly tested with record cards (paper version) and operated for six months. During this time, some 8,000 page text and figures were fed in and processed in the documentation part. Since September 1972, the prototype system RESI-2 has been operated by Siemens AG with the help of the GOLEM system. In particular, after the conversion to the EDV supported RESI-2 system, the significance of a careful processing procedure during the indexing process became evident. (GE)

12044 ANALYSIS BY RELAP-2 CODE FOR BLOWDOWN EXPERIMENTS SIMULATING A LOSS-OF-COOLANT ACCIDENT IN BWR. Sobajima, M. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 8, 562-568(Aug 1973). (In Japanese).

An evaluation of the RELAP-2 code for blowdown analysis is given, using the results of the ROSA experiment which simulates a loss-of-coolant accident in light water reactors. The values of the parameters in the model were varied for different experimental conditions to give good agreement of the pressure and temperature transients with experimental data. The variation thus necessitated indicates that the mass velocity table given by Moody has to be modified for the location and the size of the break. (auth)

Reactor Theory and Calculation

Refer also to abstracts 11892, 11898, 11906, 11914, and 11929.

12045 (AEEW-R-530) PRESTO I: A PROGRAMME FOR MULTIGROUP SOURCE-SINK CALCULATIONS IN PRESSURE TUBE REACTOR LATTICES. Allen, F. R. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Feb 1968. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

Declassified Aug 1973.

A description is presented of the physics model, the numerical methods of solution and the user aspects of the computer program PRESTO 1. PRESTO 1 has been written to perform reactor calculations with a multi-group source-sink treatment of a two dimensional model of a cylindrical reactor. Classical Feinberg-Galanin theory is used as extended to deal with finite channels by, for example, Blackburn and Auerbach. The program has been developed for studies of pressure tube reactors and includes a general treatment of both monopole and dipole components of the flux solutions. The separate development of this method for pressure tube reactors has been necessary first, to provide a code for use on the IBM 7030 STRETCH as available to the AEE Winfrith. Second, it has been necessary to incorporate numerical methods which achieve convergence in problems using the energy group structure of the Winfrith five group scheme. This five group scheme is a feature of the pressure tube option in the METHUSELAH lattice code which can be used to generate the data required by PRESTO. Third, it was desirable to develop a theoretical model to include general boundary conditions for both monopole and dipole components of the fluxes at the channel/moderator interface. A special code called QUAVER is available which provides the general monopole and dipole boundary condition data for PRESTO. (UK)

12046 (BNWL-1656) UNCERTAINTIES IN THE ANALYSIS OF PLUTONIUM FUELED LIGHT WATER MODERATED ASSEMBLIES. Liikala, R. C.; Uotinen, V. O.; Jenquin, U. P. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). May 1973. Contract AT(45-1)-1830. 137p. Dep. NTIS $3.00.

A theoretical analysis of UO_2-PuO_2 fueled, light-water-moderated lattice experiments has been performed to aid in establishing technical bases and design criteria for the utilization of plutonium bearing fuel in thermal power reactors. Results for UO_2 and Al–Pu lattices are included in order to understand the effects due to uranium and plutonium separately. The problems involved in calculating high leakage critical experiments are discussed. Estimates of the effects of various approximations inherent in the theoretical methods and/or analysis procedures are included along with the consequence on the results of the correlation. Uncertainties in the measurements and the neutron cross-section data are related to uncertainties in the calculated values k_{eff}. The results of other studies which bear on evaluating the calculational methods are summarized. Areas which should be investigated in future analyses are also identified. (111 references) (auth)

12047 (INIS-mf-530) IMPROVEMENTS TO THE THEORY AND CALCULATIONS OF THE RESONANCE ABSORPTION AND MULTIGROUP CONSTANTS WITH TEMPERATURE DEPENDENCE IN NUCLEAR REACTORS. De Francisco, J. L. (Junta de Energia Nuclear, Madrid (Spain); Zaragoza Univ. (Spain). Facultad da Ciencias). 1972. 184p. (In Spanish). INIS.

An analysis of a subject that is essential to the detailed understanding of neutron transport in a nuclear reactor is undertaken: the dependence of the cross section of the heavy elements averaged over the neutron spectrum in the energy range where the cross sections show resonances. A general expression is obtained for the resonance integral taking into account the effect of interference between the potential and resonance scattering as well as the temperature of the medium, all within the scheme of the approximation of intermediate resonance. An interpolation formula is developed that permits the rapid determination of the dependence with the temperature of the group constants previously tabulated for certain definite values of the temperature. (tr-auth)

12048 (INIS-mf-850) TRENDS IN REACTOR THEORY AND EXPERIMENTS. Rastogi, B. P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 18p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A brief history of reactor experiments and theory is given. The present activity in this field is discussed in some detail. Some projections of future trends have also been made. (auth)

12049 (KFKI-73-48) NEUTRON THERMALIZATION CODE RJT4-CATHY. Gado, J.; Szatmary, Z.; El-Wakil, S. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). [nd]. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

For solving the thermalization problem in cylindrical reactor lattice cells the RJT4-CATHY computer code has been developed. The algorithm of the code is based on the thermalization model of N. Cadilhac and on the ALCOLL subroutine of A. Kavenoky for the calculation of first collision probabilities. The short running time of the code makes it applicable for serial calculations or for the thermalization calculation in a burnup code. The testing procedure to experimental and other calculational results has not yet been finished. (auth)

12050 (NIIAR-P-150) FISSION FRAGMENT SORPTION IN THE NUCLEAR REACTOR PRIMARY CIRCUIT. Part 2. The Experimental Study of Sorption Parameters in Loop. Samsonov, B. V.; Frei, A. K. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 24p. (In Russian). INIS.

Results are presented on the absorption of fission products in a reactor loop. The distinguishing feature is that the exit rate of the isotopes is specially set. The heat transfer medium in the experiments was water at a pressure of 3 atm and a temperature to 100°C. The total beta activity of the water was ~1.0 millicurie/liter. The concentrations of iodine-131 and -133, barium-140, and molybdenum-99 were $\sim 10^8$ atoms/cm^3. In this case the adsorbed amounts of isotopes in the primary circuit were $\sim 10^9$ atoms/cm^2. It is shown that the absorption of fission products purifies the water to a significant degree. An agreement between theoretical assumptions and the experimental data is shown. (auth)

12051 (NIIAR-P-169) AUTOMATIZATION OF THE CHOICE OF A COORDINATE MESH IN Sn CODE. Zizin, M. N.; Yaroslavtseva, L. N. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 20p. (In Russian). INIS.

In reactor calculations greater attention is being directed to the problem of selecting the parameters for the calculational model of the reactor. Up to the present these problems were resolved mainly by the method of trial and error with an unjustified increase in the cost of calculation because of the required machine time. Only automation in selecting the parameters of the calculational model offers a way out of this situation. A problem of this type is considered. A series of algorithms is proposed for automatically selecting the number of calculational nodes in solving a one-dimensional kinetic equation by the Sn-method. The programs are composed in algorithmic language from these algorithms. The programs are included in a complex of programs used in the design of fast neutron reactors which are to be operated in NIIAR. The results of calculating a series of assemblies with the use of these algorithms are discussed. (auth)

12052 APPLICATION OF MONTE-CARLO METHOD TO REACTOR CALCULATION. Noack, K.; Seifert, E. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 3, 61-67(Mar 1973). (In German).

The Monte-Carlo method is a purely numerical method based on simple algorithms. Contrary to other well-known techniques of solving the Boltzmann equation it can be used to treat complex geometrics, energy dependence of cross-sections, and detailed neutron-nucleus interactions in scattering in a comparatively simple manner. The main drawback is in the slow convergence of statistical error. First the solution of transport equation is generally treated, then some special problems are dealt with. (auth)

12053 REACTOR NOISE: FUNDAMENTAL PROBLEMS AND POSSIBILITIES OF APPLICATION. Liewers, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 2, 29-37(Feb 1973). (In German).

After briefly considering the general fundamentals of noise analysis the recent status of research works and prospects in view of an application of reactor noise to routine operation of power reactors are dealt with. (auth)

12054 DETERMINATION OF DEPENDENCE BETWEEN VARIOUS REACTOR CHARACTERISTICS BY FACTOR ANALYSIS. Usynin, G. B.; Sennikov, A. A. At. Energ. (USSR); 35: No. 1, 25-27(Jul 1973). (In Russian).

A simple method of constructing a mathematical model of a reactor for use in optimization calculations is considered. The results of investigating the dependence of critical mass, breeding ratios and other characteristics of a fast power reactor on the fuel fraction, core volume and core flattening are presented. Representations of these dependences by surfaces of the first and second order are compared. (auth)

12055 LOCAL HETEROGENEOUS DESIGN OF A REACTOR. Lelek, V. At. Energ. (USSR); 35: No. 3, 159-161(Sep 1973). (In Russian).

A method for local design of a reactor is described. The heterogeneous Galanin equations are solved only within a given region (sufficiently large relative to the diffusion and moderation length), and the effect of the surrounding medium is taken into account by means of fictitious sources of neutrons. It turns out that the method is quite effective and sufficiently accurate. (3 references) (auth)

12056 MASTER EQUATIONS FOR BRANCHING PROCESSES. Sako, O. (Tokai Univ., Tokyo). Tokai Daigaku Kiyo Kogakubu; 1972: No. 2, 69-80(Mar 1973).

A class of master equations, i.e., the equations which are satisfied by the so-called probability master functions P (n_1, ... , n_i, ... , t), n_i being the number of particles in cell i are derived for various Mark ovion systems including a case of space-velocity dependent multiple components. The equations obtained are particularly applied to nuclear reactor kinetics. The new results provide the zeroth moment formalism in contrast to that of first and second moment. Some considerations are given regarding the significance of the master equations concerned and their solutions, i.e., probability master functions. For example, the new approach would make it possible to elucidate the divergent behavior of neutron fluctuations in critical nuclear reactor systems. (auth)

12057 CRITICAL MASS MINIMIZATION OF A CYLINDRICAL GEOMETRY REACTOR BY TWO GROUP DIFFUSION EQUATION. Lee, C. K. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 2, 115-131(Jun 1973).

L. S. Pontryagin's maximum principle is applied to the minimum critical mass problem without any restriction on the ranges of uranium enrichment. For the analysis, the two group diffusion equation is adopted for a cylindrical reactor neglecting the vertical axis consideration. The result shows that the three-zoned reactor turns out to be most optimal: the inner and outer zones with the minimum enrichment; whereas the middle zone with the maximum enrichment. With the given three-zoned reactor a critical condition is derived which leads to the calculation of the determinant. By finding the roots of the determinant the numerical calculation of the minimum critical mass is carried out for the case of Kori reactor geometry changing the minimum or the maximum enrichment. It is found from many computed values that the least possible critical mass turns out to be the case of 1.2% maximum enrichment for the middle zone and 0.65% minimum enrichment for the inner and outer zones. (auth)

12058 MODIFICATION TO FISSILE ELEMENT CROSS SECTIONS AND THEIR INFLUENCE ON THE CALCULATED PARAMETERS OF FAST CRITICAL ASSEMBLIES. Otake, I. (Fuji Electric Co. Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. Tokyo); 10: No. 3, 163-169(Mar 1973).

Fast cross section sets are prepared for the analysis of fast critical assemblies to test the agreement of calculated and measured integral parameters. Modifications are made to fissile element cross sections making use of recently measured cross section data, and these updated cross section data are utilized to compare the calculated integral parameters of these assemblies and to determine the effect on the calculated results by the differences between the data. The results are presented for the eigenvalue, central fission ratios, and central sample reactivity in the ^{239}Pu fueled assemblies ZPR-3-48, 49, 50 and ZEBRA-6A, whose spectra simulate those of large fast reactors. In addition, for ZPR-6-7 and ZPPR-2, which are large fast critical assemblies intended for testing the calculational procedures of practical demonstration reactor design, the results of analysis obtained with the updated cross section set are compared with experiments. It is found that the cross section for ^{241}Pu recommended here satisfactorily agrees with the experimental reactivity worth. (auth)

12059 EFFECT OF ANISOTROPY OF SCATTERING ON THERMAL UTILIZATION FACTORS. Laletin, N. I.; Sultanov, N. V.; Vlasov, Yu. A.; Konyaev, S. I. At. Energ. (USSR); 34: No. 6, 450-454(Jun 1973). (In Russian).

In the calculation of thermal utilization factors in heterogeneous reactors, anisotropic scattering is taken into account usually in the transport approximation, sometimes in the linear-anisotropic approximation. In a recent paper by G. W. Eccleston and N. I. McCormick (J. Nucl. Energy, 24, (1970)) the generally accepted view that these approximations are satisfactory for practical calculations has been challenged. The effect of the second and higher angular moments of the scattering function on the thermal utilization factor was investigated. Formulas valid for a qualitative analysis of the problem under consideration are presented and a set of cells was calculated by various methods. The conclusion is drawn that the results of Eccleston and McCormick are apparently erroneous. (auth)

12060 MONTE CARLO MODEL FOR REACTOR CORE CALCULATIONS IN THREE DIMENSIONAL GEOMETRY. Imam, M. (Univ., Kiel). Atomkernenergie; 21: No. 4, 279-289(1973). (In German).

A model in three dimensions for the neutron transport problems is presented. This model deals with reactor systems with complicated arrangements of materials. The model utilizes the multigroup Monte Carlo techniques to provide a numerical solution of the Boltzmann transport equation. Two different scattering kernels, namely the transport approximation and linear anisotropy, are considered. As a variance reducing method the model uses the statistical weights for the absorption. In addition to the calculation of the neutron spectra, the model predicts different reactor parameters that are important to reactor physics such as the absorption rate in the core and reflector, the life-time of the prompt neutrons, the fast fission factor and the reactivity. The applications of the model to FRG different core configurations showed good agreement with the experimental results. (GE)

12061 REACTOR NOISE: EXPERIMENTAL PROBLEMS. Liewers, P. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 7, 205-212(Jul 1973). (In German).

The fundamental experimental techniques of reactor noise analysis are described and compared with each other. (auth)

12062 SOME PROBLEMS OF MEASURING HIGH REACTIVITY. Volegov, V. V.; Teslenko, O. P. (Inst. of Atomic Energy, Moscow). Kernenergie; 16: No. 7, 221-224(Jul 1973). (In German).

The reactivity concept is analyzed on the basis of different possible definitions. An unambiguous definition can be given only if the effective multiplication factor is equal to 1. From the requirements applying with respect to nuclear safety of a reactor the demands can be deduced which have to be met by the quality of definition and accuracy of measurements. Discussing the well-known techniques of measurement shows that apart from experimental studies theoretical investigations always are necessary for determining the core transients. (auth)

12063 NEW EQUILIBRIUM STATE OF A PERTURBED NUCLEAR REACTOR WITH NEGATIVE FEEDBACK. Nguyen, D. H. (Naval Postgraduate School, Monterey, CA). Nucl. Sci. Eng.; 52: No. 3, 292-298(Nov 1973).

Nonlinear analysis has shown that when the buckling of a nuclear reactor with negative feedback is increased, the flux, under appropriate conditions, will proceed to a new asymptotically stable state. This contrasts with the linear theory which predicts a runaway. The method of "coordinate stretching" has been used to obtain the asymptotic solution of a nonlinear nuclear reactor under the combined effect of an initial positive disturbance and a negative feedback based on the Newton's law of cooling. The minimum stability condition is derived by requiring that a bounded new equilibrium state exist. This condition sets an upper limit to the

magnitude of the initial disturbance beyond which an equilibrium solution does not exist. Furthermore, the magnitude of the equilibrium flux is determined explicitly in terms of several relevant physical properties of the system: feedback coefficient, energy production rate, and rate of energy transfer to coolant. (auth)

12064 MEASUREMENTS OF THE THERMALIZATION OF NEUTRONS IN A CYLINDRICAL SHELL. Rehman, A. U.; Andrews, D. G. (Univ. of Toronto). Nucl. Sci. Eng.; 52: No. 3, 321-329(Nov 1973).

The thermalization of neutrons was experimentally measured for the purpose of testing Kushneriuk's thermalization calculation in a cylindrical shell of moderator surrounding a fuel rod in a thermal reactor. The basis of the study was the measurement of activations for a set of five detectors—^{55}Mn, ^{197}Au, ^{115}In, ^{239}Pu, and ^{176}Lu—inside the central fuel rod and the surrounding moderator at 20-cm hexagonal lattice pitch in the Atomic Energy of Canada Ltd.'s (AECL's) heavy-water-moderated, natural uranium critical reactor, ZEEP. The neutron flux distribution, calculated by Kushneriuk's method (first-order and exact solutions), was used in calculating detector activations. When compared, the measured detector activations and those calculated showed good agreement in the moderator, with the exception of points near and inside the fuel rod. The measured detector activations were also compared with the predicted values obtained from the HAMMER code. In this instance, the agreement was generally better than that obtained between measured and calculated values based on Kushneriuk's method. (auth)

12065 REACTIVITY WORTHS OF PLUTONIUM–URANIUM CLUSTERS IN A HEAVY-WATER-MODERATED ASSEMBLY BY THE REACTOR OSCILLATION METHOD. Boeuf, A.; Casini, G.; Macke, E.; Papay, L. T.; Tassan, S. (Joint Nuclear Research Center, Ispra, Italy). Nucl. Sci. Eng.; 52: No. 3, 360-381(Nov 1973).

The reactivity worths of synthetic plutonium–uranium clustered fuel elements in a heavy-water-moderated assembly have been experimentally determined using the reactor oscillation method. Several test-fuel compositions have been investigated, representing varying degrees of fuel burnup and burnup distributions; two uranium samples with different ^{235}U enrichment have been used as standard. The technique selected was aimed to establish "clean" experimental conditions, in order to effectively simplify the analysis of the results. Basically, the technique involved oscillating, according to a square-wave pattern, a 6-m-long fuel element containing a 50-cm-high test section with the fuel composition to be investigated; the corresponding neutron density modulation was interpreted in terms of a Fourier analysis. The results of the experiment form a consistent set of data that can be used as test values for refined reactor burnup calculation codes. The overall experimental error, typically ±0.015 pcm (1 pcm = 10^{-5} $\Delta k_{eff}/k_{eff}$), is considered remarkably low in view of the massive experimental setup required. A method for the theoretical analysis of the measured reactivity worths is presented. A multigroup perturbation transport calculation in one dimension (S_4 approximation) has been developed to account for the radial environmental conditions. The axial effects have been evaluated with a two-dimensional transport calculation. The group cross-section data used in the analysis were basically taken from the GAM-II and GATHER-II libraries. Using the same basic one-dimensional code with an appropriately adjusted input parameter, infinite lattice multiplication factors have also been calculated from the experimental reactivity results. These results are compared to the values of k_∞ obtained from null-reactivity measurements of identical clusters which were performed in association with the Comitato Nazionale Energia Nucleare, Italy, in the RB-1 Reactor in Bologna. The agreement between the two sets of results is satisfactory. (auth)

12066 USE OF SINGULAR FUNCTIONS WITH FINITE ELEMENT APPROXIMATIONS. Fix, G. J.; Gulati, S.; Wakoff, G. I. (Univ. of Maryland, College Park). J. Comput. Phys.; 13: No. 2, 209-228(Oct 1973).

Finite element approximations to elliptic problems tend to converge poorly in the presence of singularities. This is especially true of spline functions. A scheme is given for efficiently modeling singularities in conjunction with such approximating functions. Three sample physical problems are chosen to illustrate the techniques. (28 references) (auth)

12067 SIMULATION OF FAST-REACTOR SPECTRA. Applications to Calculations of Reactivity Effects and of Fission to (n,2n)-Reaction Ratios in Fast Reactors. Nishihara, H. (Kyoto Univ.); Ohta, M. J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 402-410(Jul 1973).

To simulate fast-reactor spectra, a simple shape function $f(u; u_m, B)$ with spectral parameters u_m and B has been derived by expanding the gross shape of the spectrum into a series of Hermite functions. The parameters are determined by the moment method. It is shown through some sample problems that the shape function is applicable to both core and blanket. The value of B = 0.1 is recommended for core spectra and B = 0.0 for blanket spectra. Spectral simulation with this shape function is applied to studies on the burnup reactivity and the fission-to-(n,2n) ratio of ^{232}Th and ^{238}U. (auth)

12068 REACTOR PHYSICS AS A RESEARCH AND DEVELOPMENT TASK IN THE NUCLEAR RESEARCH CENTRES. Ballensiefen, G.; (Kernforschungsanlage, Juelich, Ger.); Wolf, R.; Buenemann, D.; Kuechle, M.; Kuesters, H. Atomwirt., Atomtech.; 18: No. 8-9, 426-431(1973). (In German).

In reactor physics the research centres must in the future increasingly undertake to carry out tasks, drafting of ideas and essential parts of the feasibility studies of large nuclear projects which are then to be jointly pursued with industry. They will, therefore, also carry the research risks. Above all crucial problems of physics, safety analyses and material research should be worked on. The improvement of the accuracy of prediction in neutronics is an important aim. (GE)

12069 COMPARISON OF PROTON-RECOIL AND TIME-OF-FLIGHT NEUTRON SPECTRAL MEASUREMENTS WITH TRANSPORT CALCULATIONS IN TWO URANIUM-235-FUELED FAST SUBCRITICAL REACTORS. Verbinski, V. V. (Intelcom Rad Tech, San Diego, CA); Young, J. C.; Neill, J. M. Nucl. Sci. Eng.; 52: No. 3, 330-342(Nov 1973).

Cylindrical proportional counters were used to measure the scalar neutron flux in the core and reflector of the ^{235}U-fueled fast subcritical reactors, STSF-7 and -9. These data have been compared with time-of-flight angular spectrum measurements in the same reactors, and with transport theory calculations of these assemblies utilizing ENDF/B-III cross sections. The agreement of the two measurement techniques at high energy indicates that the emission time correction procedures used for the time-of-flight studies on subcritical (k_{eff} = ~0.92) assemblies with a 220-m flight path are reliable. At intermediate energies, the two types of measurements and the calculations were in good agreement for the STSF-9 oxide-fueled core, but significantly different for the metal-fueled STSF-7 core in the region of fine structure associated with the pronounced aluminum resonances below 300 keV. The time-of-flight data exhibited some energy mismatch here, and the 4π counter was subjected to more aluminum "shielding" than allowed for in the calculations. The shielding effect was strongest in the metal-fueled STSF-7 core, because of the absence of the oxygen moderator. At low energy, where the Doppler effects of the thermal coefficient of reactivity are concentrated, the calculations underpredict the flux. The time-of-flight data, which are the most reliable here, show the greatest disagreement with theory. (auth)

12070 IMPROVEMENTS IN THE PREDICTION OF REACTIVITY AND REACTION RATE RATIOS FOR URANIUM LATTICES. Chawla, R. (Indian Inst. of Tech., Kanpur). J. Nucl. Energy; 27: No. 11, 797-809(Nov 1973).

Evidence from a broad range of clean, benchmark experiments has been used to assess the performance of "best" available theoretical methods and differential data for predicting integral thermal reactor properties such as reactivity and reaction rate ratios. It is shown that for improving the consistency of calculated integral parameters for D_2O, H_2O, and graphite moderated, uranium fuelled systems, significant modifications to certain currently used nuclear data are desirable. Along with changes in moderator scattering cross-sections, ^{238}U resonance data and the ^{235}U fission energy spectrum, some modification of ^{235}U thermal data has been made which lies within the experimental uncertainties of differential measurements. The "new" data options have been used in various analyses with the WIMS lattice code, and results are presented for the benchmark studies and also for some lattices with more complicated geometries. It is shown that the preferred data generally gives more consistent results for both reactivities and reaction rate ratios over a wide range of conditions, than any previously considered data combinations. (auth)

12071 AN EXACT SOLUTION FOR FLOW TRANSIENTS IN TWO-PHASE SYSTEMS BY THE METHOD OF CHARACTERISTICS. Gonzalez-Santalo, J. M.; Lahey, R. T. Jr. (General Electric Co., San Jose, CA). J. Heat Transfer; 95: No. 4, 470-476(Nov 1973).

One of the important design considerations in modern water-cooled nuclear reactors is their thermal performance during hypothetical accident situations. However, an accurate analysis of the system thermal-hydraulics is required before the thermal margins can be appraised. An analysis based on the method of characteristics has been developed by which the exact solution to flow decay transients in homogeneous two-phase systems can be obtained.

The exact solution presented yields the system flow and quality at each point in space and time during an exponential flow decay transient. These parameters can then be combined with an appropriate critical heat flux (CHF) correlation to predict the occurrence of transient CHF. (auth)

12072 DETERMINATION OF FAST-NEUTRON-GROUP PARAMETERS FROM GAMMA-RAY AND THERMAL NEUTRON NOISE ANALYSIS IN THERMAL REACTORS. Baers, B. (Technical Research Centre, Otaniemi, Finland). Kernenergie; 16: No. 6, 198-201(Jun 1973).

It is experimentally verified that information concerning the fast group of neutrons in a thermal reactor can be obtained from gamma-ray noise analysis or from combined gamma-ray and thermal neutron noise analysis. Both in-core or ex-core photon detection can be applied. 14 references. (auth)

12073 MULTIGROUP NEUTRON TRANSPORT THEORY IN A SEMI-INFINITE MEDIUM. Domke, Kh. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Kernenergie; 16: No. 6, 194-198 (Jun 1973). (In German).

A new method is proposed for the exact solution of the multigroup neutron transport equation for transport problems in a plane semi-infinite medium. The transport equation together with the corresponding boundary conditions has been converted into a set of integral equations for the source functions the resolvent of which is reduced to the determination of H-matrices. For the H-matrices linear singular and nonlinear integral equations as well as a set of linear constraints have been derived. As an example the exact solutions for the albedo problem, the Milne problem, and the resolvent function have been derived. 22 references. (auth)

12074 EFFECT ON STOCHASTIC FLUCTUATIONS OF POSSIBLE NOISE SOURCES IN NON-BOILING LIQUID REACTORS. Morishima, N. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 478-488(Aug 1973).

A stochastic model of a power reactor is extended to three different reactor systems: (a) where there exists a relaxation process corresponding to the effect of buoyant flow; (b) where a control or fuel element vibrates randomly, due to coolant flow-rate fluctuations; (c) where there are fluctuations in the inlet temperature with a non-white spectrum. The noise spectra are derived for various state quantities with use made of the Langevin procedure. The theory is illustrated by referring chiefly to the neutron noise spectra, and comparing with the results of observations. It is shown that the noise sources in question contribute significantly to the spectra, as compared with a low frequency component due to an inherent noise source in the coolant flow. In particular, a strong resonance peak of the spectra arises from the coupling between the random mechanical vibrations and coolant flow-rate fluctuations. (auth)

Reactor Components and Accessories

Refer also to abstracts 10096, 10113, 10645, 10649, 10652, 10699, 10746, and 12011.

12075 (CEA-CONF-2222) PROGRAM OF STUDIES BEGUN BY THE COMMISSARIAT A L'ENERGIE ATOMIQUE IN THE DOMAIN OF THE APPLICATION OF SOME NONDESTRUCTIVE CONTROLS TO THE SAFETY OF REACTORS. Barrachin, B.; Chretien, N.; Prot, A.; Roche, R.; Saglio, R.; Tomachevski, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 5 Dec 1972. 32p. (In French). (CONF-730217-1). Dep. NTIS (U.S. Sales Only) $3.75.

From symposium on the principles and standards of reactor safety; Julich, F.R. Germany (5 Feb 1973).

The use of ultrasonics for improvement of testing procedures was studied with particular emphasis on the development of methods particularly suited to the testing of very thick welds. Some examples were given which show the efficiency of this technique in the case of inspection controls in the presence of stainless steel coatings. Developments relative to acoustical emission included the laboratory study of the acoustical emission of various reactor vessel steels; study of the modifications caused by irradiation; development of an acoustical emission detection chain and processing of the data in order to locate the emissive sources; and study of transducers associated with this chain. Other studies briefly mentioned were: acoustical holography (a method of examination which should remove many of the uncertainties in the characterization of faults detected by ultrasonics), ringing method which should complement the detection of serious defects, and improvement of the radiographic image qualities to extend the range of radiography and obviate some inhibitory inconveniencies. (JSR)

12076 (CEA-CONF-2256) SURVEILLANCE OF REACTORS BY THE METHODS OF DETECTION OF EMISSION OF WAVES OF CONSTRAINT AND BY ACOUSTIC DETECTION. Gasc, B.; Tomachevsky, E. G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 19p. (In French). (CONF-730108-12; SM-168-D-6). Dep. NTIS (U.S. Sales Only) $3.00.

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

All programs of surveillance and inspection in service by detection of stress wave emission (or acoustic emission) are divided into three distinct phases--research on the characteristics of materials, study of the propagation of signals in structures, and localization of emissive sources. The techniques used in each of these phases are outlined. Acoustic detection is used for the control and the good operation of an ensemble. The circumstances of detection of acoustic waves are described and examples are given. Perspectives for the improvement of the procedure are indicated. (JSR)

12077 (CONF-720482-) STRUCTURAL DESIGN OF NUCLEAR POWER PLANT FACILITIES. Proceedings of Symposium, Pittsburgh, Pennsylvania, April 20-21, 1972. Abrams, J. I.; Stevenson, J. D. (eds.). (Pittsburgh Univ., Pa. (USA). Dept. of Civil Engineering). Dec 1972. 854p.

Separate abstracts are included for 33 of the 34 papers presented concerning seismic analysis of building structures and development of floor response spectra; analysis of building structures for tornado, jet load, missile penetration, and impact effects; seismic design of equipment, components, and supports; and analysis of nuclear plant equipment and piping systems for missile, pipe break, pipe whip, and jet load effects. One paper has been previously indexed and included in NSA under the following abstract number: 27:29464. (DCC)

For abstracts of individual papers see: 11746-11750, 11770-11772, and 12078-12102.

12078 (CONF-720482-, pp 3-14) SOME CONSIDERATIONS IN THE ASEISMIC ANALYSIS OF NUCLEAR POWER PLANTS. Chen, C. (Gilbert Associates, Inc., Reading, PA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Some analytical methods for aseismic analyses are introduced. The floor response spectrum for light equipment can be generated either from time history or ground response spectrum. In the time history approach, methods of generating simulated time history are discussed. In the response spectrum analysis, different methods of combining modal response with close frequency were considered. The subject of soil structure interaction is discussed. In conclusion, parametric study is suggested whenever uncertainty arises. (32 references) (auth)

12079 (CONF-720482-, pp 15-37) SOME NOTES FOR SEISMIC ANALYSIS ON NUCLEAR PLANT FACILITIES. Chu, S. L. (Sargent and Lundy Engineers, Chicago). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The methods using finite elements to evaluate the effects of soil-structure interaction are discussed; these methods are particularly suitable to study buildings embedded in shallow layered soil stratum. Also discussed is a spectral treatment of the effect of three earthquake components on structures; suggestions are given for combining the effects of three components of motion in a probabilistic manner. (14 references) (auth)

12080 (CONF-720482-, pp 38-67) COMMENTS ON SOME ASPECTS OF SEISMIC ANALYSIS OF BUILDING STRUCTURES AT TVA NUCLEAR PLANTS. Domer, R. G. (Tennessee Valley Authority, Knoxville). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The soil structure interaction topic is considered. A series of parameter studies were performed to ascertain the effect. A single structure was examined and the response determined. Several structures coupled to the same base slab were also studied. (auth)

12081 (CONF-720482-, pp 68-73) SOME NOTES ON SEISMIC ANALYSIS FOR NUCLEAR POWER PLANTS. Kuo, H. J. (Ebasco Services, Inc., New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Three items of practical interest to designers are briefly discussed. They include: the selection of appropriate structural

damping values, modeling techniques for soil structure interaction, and combining procedures for the various mode contribution. Experience in each of these areas is indicated. (auth)

12082 (CONF-720482-, pp 114-168) METHODS OF DETERMINING FLOOR DESIGN RESPONSE SPECTRA. Stoykovich, M. (Gibbs and Hill, New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

From the standpoint of dynamic analysis of nuclear power plants subjected to seismic disturbances the plant structure can be divided into two categories: primary and secondary structures and systems. This is necessary because it is not feasible to formulate one mathematical model which would, in addition to the primary structure, include all of the equipment, piping systems and other light weight structures. The latter very often has to be uncoupled from the model representing the primary structure. These uncoupled mathematical models are sometimes called models of secondary structures or systems and can be analyzed by using a shortcut procedure of response spectrum approach. Spectral analysis avoids the tedious operation for performing a lengthy step-by-step integration by digital computers. To utilize spectral analysis for secondary systems, floor response spectra have to be developed. The methods used in arriving at the floor response spectra are described. (4 references) (auth)

12083 (CONF-720482-, pp 169-204) VARIATION OF INPUT PARAMETERS CONSIDERED IN DETERMINING FLOOR RESPONSE SPECTRA. Stoykovich, M. (Gibbs and Hill, New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The engineering ideal is to start with a correct specification of the earthquake ground motion that the structure will experience and accurate physical properties of the structure, and then to compute precisely the seismic responses. However, this is not practically possible. Since the frequencies of the structure can only be approximately computed because of the linear and nonlinear deformability, the energy dissipation, variation in elastic properties of both structure and foundation and the idealization of structure with lumped masses and elastic properties in discrete parts parametric studies have to be performed in order to take into account these variations for construction of floor response spectra. Moreover, damping ratios associated with the foundation-structure interaction as well as those of the superstructure cannot be readily determined. Hence, these parameters will also affect development of floor response spectra. (10 references) (auth)

12084 (CONF-720482-, pp 205-231) SOME TECHNIQUES FOR SEISMIC ANALYSIS OF NUCLEAR POWER PLANTS. Tsai, N. C. (Bechtel Corp., San Francisco). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

For seismic analysis of nuclear power plants, a technique is presented for generating synthetic, spectrum-compatible motions. A technique is also presented for formulating a soil-structure system in which the structure is represented by its normal modes. For modal analysis of this interaction system, a transfer function matching technique is presented for the determination of the composite soil-structure damping for each mode. (8 references) (auth)

12085 (CONF-720482-, pp 246-251) TORNADO AND MISSILE PROBLEMS. Alexander, H. (American Electric Power Service Corp., New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Some of the problems faced by utility engineers in facility design are presented. Both tornado and environmental missiles are considered. (auth)

12086 (CONF-720482-, pp 287-300) ANALYSIS OF BUILDING STRUCTURES FOR TORNADO, JET LOAD, MISSILE PENETRATION, AND IMPACT EFFECTS. Johnson, T. E. (Bechtel Corp., San Francisco). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Tornado structural loading, tornado missile and jet loads are reviewed. Missile penetration is also considered. The design of structural elements subjected to impulsive and impact loads is discussed. (4 references) (auth)

12087 (CONF-720482-, pp 301-311) ANALYSIS OF BUILDING STRUCTURES FOR TORNADO, JET LOAD, MISSILE PENETRATION, AND IMPACT EFFECTS. Kanakaris, G. A. (Ebasco Services, Inc., New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The nuclear power plant is unique in the extreme loading conditions a designer must consider to assure the integrity of structures and systems necessary for the safety and protection of the public. Criteria for the analysis and design of structures for tornadoes, jet loads and missiles are presented as a general review of the current state of the art. (6 references) (auth)

12088 (CONF-720482-, pp 312-319) STRUCTURAL DESIGN OF NUCLEAR POWER PLANT FACILITIES. Koppe, R. E. (Sargent and Lundy Engineers, Chicago). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

An overall view of some of the considerations of missile impact and penetration is presented. Mechanisms for resisting impact damage are presented. Also included are separate discussions of design of missile resistant panels and criteria for design of pipe whip restraints. (auth)

12089 (CONF-720482-, pp 320-352) DESIGN OF MISSILE RESISTANT CONCRETE PANELS. Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Protection against structural failure in case of accidental impact of several types of projectiles must be a consideration in nuclear power plant design. A method for analyzing reinforced concrete plate elements subject to impact loads is presented. A procedure for computing various critical quantities is outlined. The walls surrounding critical equipment areas are usually made up of a series of concrete panels. A number of different flying objects have been postulated as possible missiles in previous power plant designs, including a crashing airliner. (auth)

12090 (CONF-720482-, pp 353-360) CRITERIA FOR THE DESIGN AND ANALYSIS OF PIPE WHIP RESTRAINTS. Koppe, R. E. (Sargent and Lundy Engineers, Chicago). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Due to the dynamic effect of pipe rupture, restraints designed to limit the pipe motion cannot be designed by conventional static procedures. An energy balance design is needed to completely account for the dynamic effects. A background for this criteria is presented. (auth)

12091 (CONF-720482-, pp 361-397) DYNAMIC ANALYSIS OF MISSILE IMPACT PROTECTION FOR REINFORCED CONCRETE SLABS. Lee, A. J. H. (Gilbert Associates, Inc., Reading, PA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Methods of dynamic analysis of missile impact on simple target structures are presented with the aid of empirical penetration formulas and the integral equation first introduced for the dynamic response of beams under lateral impact. In general, the impact forcing function depends on the penetration depth, missile's impact velocity, as well as the response and vibration characteristics of the target structure involved. The conditions under which the impacted targets will experience collapse are formulated, using an equivalent one-degree-of-freedom model. Also, the effects of distributed pressure on the plastic behavior of the targets are discussed and the possibility of establishing the so called punching shear criterion for missile impact mentioned. (8 references) (auth)

12092 (CONF-720482-, pp 409-417) TORNADO DESIGN OF CLASS I STRUCTURES FOR NUCLEAR POWER PLANTS. Stevenson, J. D. (Westinghouse Nuclear Energy Systems, Div., Pittsburgh). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Simple vortex flow models are presented which define the wind velocity component and differential pressure at any point in the cyclonic field. The parameters used to quantify these values have been developed from observed tornado data and may be used with the simple model to specify more completely the Design Basis Tornado. These wind and pressure effects can be combined to determine structural load on building surfaces. Using automated finite element structural design techniques which readily permit nonsymmetric loading it is possible to perform more rational tornado structural design. (12 references) (auth)

12093 (CONF-720482-, pp 418-445) IMPACTIVE DYNAMIC ANALYSIS. Suarez, M. A. (Bechtel Corp., Gaithersburgh, MD). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Formulations of terminal ballistics were not meant for extrapolation to cover the cases presented. Further, they deal only with penetration. Structural stability is best ascertained by solving the equation of motion for impulsive as well as for impactive loading. In impulsive loading, only the forcing function need be known, while in impactive loading the general shape of this function, supplied by experiments, must be adapted to principles of momentum and energy transfer. The uniform ballistic pulse and the nonuniform aircraft-collision pulse are presented. The first one is typical for all missiles of high buckling loads, while the second one is typical of those of low buckling loads. Available specific energy to resist perforation should be determined experimentally following the guidelines and principles developed here. A handbook method is presented for maximum conservatism. (7 references) (auth)

12094 (CONF-720482-, pp 460-477) STRUCTURAL DESIGN OF NUCLEAR POWER PLANT FACILITIES. Goldstein, N. (Stone and Webster Engineers, Boston). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Problems associated with the proof of seismic adequacy of seismic Category I components are discussed. These structures, systems, and components are those necessary to assure: the integrity of the reactor coolant pressure boundary; the capability to shut down the reactor and maintain it in a safe shutdown condition; and the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of 10 CFR, Part 100. (auth)

12095 (CONF-720482-, pp 478-487) DESIGN OF CRITICAL NUCLEAR PLANT EQUIPMENT FOR SEISMIC LOAD. Juday, D. A. (Bechtel Corp., San Francisco). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The methods of analysis and design of critical nuclear power plant equipment for seismic loads are discussed. The methods, and the problems encountered, are illustrated by the analysis of piping systems. These methods can be applied to other items of equipment. (auth)

12096 (CONF-720482-, pp 488-495) SEISMIC ANALYSIS OF AUXILIARY EQUIPMENT. Lin, C. W. (Westinghouse Electric Co., Pittsburgh). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The presentation discusses the organization and flow of information between the contractor or owner and the vendor necessary to develop and to verify seismic design adequacy of equipment. Several specific components and the metlevels and assumptions used in developing mathematical models of their dynamic behavior are discussed. Finally, the frequency response of several classes of components has been plotted as a function of component size in order to develop a feel for the relative stiffness of various components as a function of their physical dimensions. (auth)

12097 (CONF-720482-, pp 508-514) STANDARDIZATION OF SEISMIC DESIGN TERMINOLOGY, ANALYSIS AND TEST PROCEDURES. Meligi, A. E. (Sargent and Lundy Engineers, Chicago). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A terminology which may be used to define the various types of Safety Class Components is presented. Included also is a general discussion of the various test procedures and analytical methods which should be used for design of safety class components. (auth)

12098 (CONF-720482-, pp 515-540) SEISMIC DESIGN STANDARDS FOR QUALIFYING NUCLEAR PLANT COMPONENTS. Mysinger, E. D. (Tennessee Valley Authority, Knoxville). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

A series of Seismic Design Standards for Qualifying Nuclear Plant Components are under development by the Tennessee Valley Authority. A list of the Standards under development is as follows: Design Criteria for Seismically Qualifying Mechanical and Electrical Equipment Devices; Design Criteria for Seismically Qualifying Mechanical and Electrical Equipment Assemblies; Design Criteria for Seismically Qualifying Large-Diameter Piping Systems; Design Criteria for Seismically Qualifying Small-Diameter Piping Systems; Design Criteria for Seismically Qualifying Buried Piping Systems; Design Criteria for Seismically Qualifying Tanks and Their Supports; Design Criteria for Seismically Qualifying Field Run Piping; Design Criteria for Seismically Qualifying Round and Rectangular Duct; and Design Criteria for Seismically Qualifying Pipe Supports. The first two standards have been completed and the Standard for Qualifying Mechanical and Electrical Devices is presented. (auth)

12099 (CONF-720482-, pp 541-575) USE OF FLOOR OR GROUND RESPONSE SPECTRUM. Stoykovich, M. (Gibbs and Hill, New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The use of earthquake response spectrum concept provides a convenient procedure for seismic designs and analyses of structures and systems of nuclear power plants. Spectrum analysis is an approximate method for determining seismic response of an elastic multidegree-of-freedom system. The use of response spectra for two structures is presented. Comparison of the seismic response of a structure obtained by means of spectrum analysis and time-history analysis is also shown. Only linear elastic lumped systems can be analyzed by the short-cut procedure of response spectrum concept. (3 references) (auth)

12100 (CONF-720482-, pp 576-614) USE OF TIME HISTORY ANALYSIS. Stoykovich, M. (Gibbs and Hill, New York). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The use of time-history seismic analysis of complex structures, equipment and piping systems of nuclear power plants represents a rigorous solution for obtaining the response to a given time dependent ground motion. The present availability of large digital computers gives hope that this rigorous solution may be realized some day. There are insufficient ground motion records available to enable one to correctly specify an appropriate earthquake ground motion for a particular site. At the present state of the art, several actually recorded accelerograms are required for the seismic analysis of nuclear power plant components. Simulated earthquake motion which corresponds to a given ground response spectrum can also be used. The use of time-history analysis with several examples is presented. (auth)

12101 (CONF-720482-, pp 629-764) ANALYSIS OF NUCLEAR PLANT EQUIPMENT AND PIPING SYSTEMS FOR MISSILE, PIPE BREAK, PIPE WHIP, AND JET LOAD EFFECTS. Cho, F. L. (Sargent and Lundy, Chicago). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

Overall basis and analytical methods used to determine the effects of missile, pipe break, pipe whip and jet load on the nuclear plant equipment and piping systems are presented. Each topic in the text has not been widely discussed in the industry and reflects only current thought in the state-of-the-art. (auth)

12102 (CONF-720482-, pp 786-808) SUGGESTIONS FOR THE ANALYSIS OF PIPE WHIP RESTRAINTS IN NUCLEAR POWER PLANTS. Patterson, G. J. (Gilbert Associates, Inc., Reading, PA). Dec 1972.

From symposium on structural design of nuclear power plant facilities; Pittsburgh, Pennsylvania, USA (20 Apr 1972).

In structural design of nuclear power plant facilities.

The designer of pipe whip restraints must contend with a variety of problems not encountered in routine practice. The combined effect of blowdown and impact forces is usually sufficient to strain both the pipe and restraints well beyond the elastic regions. It is suggested that the non-linear dynamic solution be approximated by a single-degree-of-freedom energy balance analysis based on conservative assumptions. Thus, emphasis has been placed on deriving relatively simple expressions that can be applied to typical pipe whip restraint design problems. Some consideration is given to means by which account can be taken of other phenomena such as strain rate effect and stress resultant interaction. (7 references) (auth)

12103 (CONF-730942-(P2)) STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. Volume 2. Reactor Components. Part E. Shock and Vibration Analysis of Reactor Components. Part F. Structural Analysis of Reactor Core and Coolant Circuit Structures. Preprints of the 2nd International Conference, Berlin,

Germany, 10–14 September 1973. Jaeger, T. A. (Comp.). (Commission of the European Communities, Brussels (Belgium); Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1973. 552p. (In several languages).

Separate abstracts are included for each of the 46 papers presented concerning shock and vibration analysis of reactor components and structural analysis of reactor core and coolant circuit structures. Seventeen citations are title-listed only because the papers are not included in the proceedings. (DCC)

For abstracts of individual papers see: 11751, 11773–11775, 11791–11795, 11815–11818, 11862–11873, 11996–12012, and 12104–12124.

12104 (CONF-730942-(P2), pp vp Sect. E4/1) RESPONSE OF NUCLEAR STRUCTURAL SYSTEMS TO TRANSIENT AND RANDOM EXCITATIONS, USING BOTH DETERMINISTIC AND PROBABILISTIC METHODS. Hitchings, D. (Imperial Coll. of Science and Tech., London); Dance, S. H. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The finite element is commonly used for the static analysis of reactor components and the same ideas can be applied to the dynamic analysis. The formation of various damping matrices for both internal and external damping is discussed. The type of solution adopted depends upon both the force input and the required response. For a short period transient input usually only the initial response is required which is best found from a step-by-step integration. A method involving a Taylor series and curve fitting over a series of steps is developed and applied to the previous example and the two solutions are compared illustrating the advantages and disadvantages of each method. For random excitation methods of presenting information are discussed standard results for the stationary problem are presented. As an example the spectral density of the response due to random imposed movements is given illustrated by a series of heat exchange tubes excited by random end movements. The probability that any interference will occur with clashing at a particular velocity is determined. The response due to a non-stationary force input such as an earthquake is discussed. The step-by-step method of analysis is used to predict the probability density function of the response of a simple system at any time under such a non-stationary input. Possible modes of failure with reference to reactor components are discussed and indications of how the proceeding theory can be applied to predicting failures are given. 12 references. (auth)

12105 (CONF-730942-(P2), pp vp Sect. E4/6) FREE VIBRATION OF A CYLINDRICAL SHELL WITH A HEMISPHERICAL HEAD. Hammel, J. (Technische Hochschule, Darmstadt, Ger.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The mutual interference of shell structures is studied in the example of free vibration of a cylindrical shell with a hemispherical head. The problem of free vibration of a cylindrical shell with a hemispherical head can be solved by the application of the solutions of the free vibrations of a spherical shell and of a cylindrical shell. Four boundary conditions at the edge of the cylindrical shell and eight junction conditions (four continuity conditions and four equilibrium conditions at the junction) yield a set of twelve equations in the twelve unknown constants A_m^n and W_m. Since these conditions are homogeneous, the determinant of these equations must be zero for nontrivial solutions leading to the corresponding frequency. The results of parametric calculations (parameters h/R and L/R) are discussed. 6 references. (auth)

12106 (CONF-730942-(P2), pp vp Sect. E4/7) FINITE DYNAMIC RESPONSE OF THIN PLATES SUBJECT TO DYNAMIC LOADING. Nash, W. A.; Kanematsu, H. (Univ. of Massachusetts, Amherst). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Flat plate-like structural components of reactors are frequently subject to loadings that vary in a random manner with respect to time and are of such intensity that finite deflections of the plate occur. For such large deflections the responses of the plate are described by a pair of coupled nonlinear partial differential equations involving the lateral deflection and a stress (potential) function as unknowns. The present investigation treats, for the first time, the large amplitude responses of plates subject to non-white random excitation. In fact, the techniques presented are applicable to arbitrary power spectra of loading. The procedure is to reduce the coupled partial differential equations of motion to a system of nonlinear ordinary differential equations for the generalized coordinates by expanding the deflection into a series of coordinate functions with time-dependent coefficients and then employing variational procedures. These coordinate functions satisfy boundary conditions and in fact may be taken as the eigenfunctions of undamped free vibration if these are known. If they are not known (for unusual boundary conditions) then products of appropriate "beam functions" representing the plate as a collection of strips in the two orthogonal directions may be employed. The significant point of the investigation is the solution of the nonlinear equations and method of equivalent linearization. As illustrations of this method, the mean-square response of a simply supported rectangular plate to both white as well as non-white random excitations is determined. It is shown that the response corresponding to the fundamental mode is predominant if the damping of the system is small and if the power spectral density of the excitation does not have any sharp peaks near the higher mode frequencies. In summary, the new approach provides statistical descriptions of structural response to arbitrary power spectral density forces by approximate analytical methods thereby avoiding the tedious numerical computations associated with other approaches. 6 references. (auth)

12107 (CONF-730942-(P2), pp vp Sect. E5/5) PROPAGATION PATTERN OF ACOUSTICAL WAVES IN AN INTERNAL FLOW THROUGH DISCONTINUITIES, THEORETICAL AND EXPERIMENTAL STUDIES. Guerin, B. (Institut National des Sciences Appliquees, Villeurbanne, France); Lesueur, C.; Baylac, G. 1973. (In French).

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The problem involved in computing response of structures subject to pressure fluctations necessitates the attainment of: the local fluctuations level expressed by way of the power spectra density; the characteristics versus time and space of these fluctuations from the standpoint of usual turbulence; and the acoustical energy due to the response of acoustical modes of the duct. An internal flow in a duct with discontinuities such as a sharp contraction or expansion is studied. A theoretical study gives the acoustical modes knowing the boundary conditions involved by the duct as well as the flow characteristics. The experimental study is achieved on a model with and without flow pattern. The acoustical modes without flow are energized by way of a loud speaker delivering a "white noise" and the damping characteristics are determined by different methods. When a flow runs in the duct, the variation of the loss factor is given for different points characterized by their average velocity. 6 references. (auth)

12108 (CONF-730942-(P2), pp vp Sect. F3/5) EFFECTS OF FLANGES ON SMOOTH PIPE BENDS IN PIPING SYSTEMS. Findlay, G. E. (Paisley Coll. of Tech., Scotland); Spence, J. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A non-axisymmetric theoretical solution for the in-plane bending of smooth bends with rigid flanges as end constraints is presented. The method of treatment involves assuming suitable expressions for deformations and the application of the Theorem of Minimum Potential Energy. First approximation results for flexibility and peak stressing characteristics are tabulated and compared with corresponding values based on the well-known Karman axisymmetric predictions. The few relevant publications which are available are briefly reviewed for completeness. The present results for different subtended bend angles indicate quite conclusively that rigid flanges can have pronounced effects. In particular, flexibility and maximum stress factors can be many orders of magnitude less than the values predicted by existing theories. From a pipework designer's standpoint, the latter observation regarding stresses may not be too undesirable but the conclusion on the effects of flanges on flexibility features is far reaching and consequently warrants attention. Current design techniques based on axisymmetric assumptions over-estimate flexibility and hence underestimate the terminal reactions exerted by piping systems on adjacent structures. 8 references. (auth)

12109 (CONF-730942-(P2), pp vp Sect. F3/6) INFLUENCE OF NON-CIRCULARITY ON THE CREEP OF SMOOTH CURVED PIPES. Spence, J. (Strathclyde Univ., Glasgow). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A theoretical creep analysis is presented which is an extension of an analysis on circular bends and recent linear elastic work on elliptical cross-sections. Pipe bend behavior is of most interest in a bending situation where its flexibility can contribute significantly to the overall system design. Consequently, in-plane bending loading is considered in this first analysis. The analysis is based on an energy method coupled with a stationary creep constitutive relationship in the form of a simple power law. Conventional strain rate, displacement relations for rotationally symmetric thin shells, are used slightly modified. The initial

cross-sectional shape is assumed to be elliptical but of constant thickness. Thickness variations are shown to be of less importance than the cross-sectional shape. A sufficiently general series expansion is assumed for the deformation of the bend and the energy dissipation rate minimized to obtain solutions for any desired numbers of terms in the series. Thus it is possible to check convergence of the solution at all practical values of the pipe bend geometric parameters. The minimization is performed using a recent computerized optimization technique and it is easily verified that the results are lower bounds on deformation. Deformation results are defined relative to the behavior of a straight pipe but can also be given in terms of the powerful reference stress technique, the latter being attractive because of the consequent economy in material data requirements. Stationary stresses can be found as factors related to the linear elastic stress in a simple beam. The results have profound implications for elevated temperature pipework design but are simple enough to be of direct use without detailed knowledge of the theoretical background. 7 references. (auth)

12110 (CONF-730942-(P2), pp vp Sect. F3/7) EXPERIMENTAL RESEARCH ON ELASTO-PLASTIC BEHAVIOR AND COLLAPSE LOAD OF STATICALLY INDETERMINED SPACE TUBULAR BEAMS. Del Puglia, A.; Nerli, G. (Univ., Pisa, Italy). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The aim of the present work is to check, by experimental verification, the adequacy of plastic analysis techniques, particularly limit analysis, for the determination of the load carrying capacity for the particular matter of thin, tubular, statically undetermined space beams. Ten models have been tested. Eight models are manufactured in stainless steel (AISI 316) and two in carbon steel (Fe 42). They have different diameter-to-thickness ratios. The axis line is the same for all models. The models have been tested under quasi-static concentrated load, increasing until collapse. The collapse is caused mainly by combined action of bending and twisting moments. The load-deflection relationship and the plastic hinge formation mechanism have been studied. Particular attention, in the analysis of results, has been dedicated to local plastic instability and to out-of-roundness deformation effects of sections and to their influence on the collapse load. The tests have been performed on a testing facility designed to the specific aim of these model structures. The calculated values of collapse loads have been determined by limit analysis, on the basis of the lower-bound theorem, using linear programming on an IBM 360/67 system. 7 references. (auth)

12111 (CONF-730942-(P2), pp vp Sect. F4/4) PLASTIC INSTABILITIES OF TEES EXPOSED TO OUT-OF-PLANE COUPLES. Schroeder, J. (Univ. of Waterloo, Ont.). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

As a result of a recent theoretical and experimental investigation conducted at the University of Waterloo on external limit loads applied to branches of tees, i.e., two normally intersecting thin cylindrical shells, it has been concluded that tees exposed to out-of-plane couples acting on the branch may become plastically unstable before a limit load is established. An out-of-plane couple is a design load which consists of two parallel forces equal in magnitude but opposite in direction generating a moment which bends the tee in a direction normal to the longitudinal central plane of the intersection, which is the y,z-plane. A number of specimens have been tested indicating that instability prevails if the d/D ratio exceeds 0.5 for relatively thick tees, where d and D is the mean diameter of branch and pipe respectively. Instability appears to be due to local denting in the pipe for the smaller diameter ratios and is caused by gross deformation of shape if the d/D ratio approaches 1. Since instability increases with increasing diameter/thickness ratio, thin tees may buckle under out-of-plane couples for d/D ratios smaller than 0.5 and consequently, limit design for externally loaded tees has to be restricted by a stability boundary. It appears to be feasible that very thin tees with diameter/thickness ratios greater than 200 may be elastically unstable under out-of-plane couples applied to the branch long before the branch becomes unstable as a cylindrical shell. (auth)

12112 (CONF-730942-(P2), pp vp Sect. F4/6) APPLICATION OF SHELL EQUATIONS TO UNSYMMETRICALLY LOADED COMPOUND SHELLS. Sutcliffe, W. J. (Univ. of Liverpool). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A number of systems of equations are available in the literature for the stress analysis of shells of revolution under lateral loading. Although numerical integration of any of these systems is in principle straightforward, in practice, the application to shells, with negative curvature elements and complex boundary conditions, can give rise to difficulties and there are few cases documented of detailed results for unsymmetrically loaded shells. Eight first differential equations have been derived for the general axisymmetric shell of revolution under lateral loading. These have been integrated to find the stress distributions in a corrugated tube or bellows, under lateral loading. Details are given of the independent cases to be considered, the treatment of negative curvature elements and the boundary conditions assumed. The results of loading tests on a model are compared with the theoretical curves of stress distributions for the complete shell. Although the results are complex in detail and not immediately obvious, the agreement of experiment and theory gives confidence in their accuracy. Particular care has been found to be necessary in order to get the correct number of independent cases for numerical integration. In addition, the signs of the variables at junctions between corrugations have required special consideration. The formulation of the shell equations used is very much simpler than some which have been proposed. (auth)

12113 (CONF-730942-(P2), pp vp Sect. F5/1) THEORY ON THE TWO-PHASE FLOW INDUCED VIBRATIONS IN PIPING SYSTEMS. Hara, F. (Science Univ. of Tokyo). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

A theoretical analysis of two-phase (gas + liquid) flow induced vibrations in piping system is presented. The mechanism of exciting the vibrations is so called parametric excitation due to periodic changes of the mass of the system, centrifugal force and Coriolis' force of liquid pistons travelling in the pipe. The equation of motion of the piping system conveying two-phase fluid is formulated from considering elastic restoring force; inertia force acting on the pipe and two-phase fluid; centrifugal force and Coriolis' force caused by travelling liquid pistons and the momentum change of two-phase flow. In the case where there is no effect of gravitation on the vibrational system, the two-phase flow induced vibration is dominantly caused by the parametric excitation due to the mass change of two-phase flow and that of centrifugal force and Coriolis' force. 13 references. (auth)

12114 (CONF-730942-(P2), pp vp. Sect. F5/4) ANALYSIS OF THE DYNAMIC ELASTO-PLASTIC BEHAVIOR OF A PIPE DURING THE PIPE WHIP ACCIDENT. Dini, D.; Lazzeri, L. (Comitato Nazionale per l'Energie Nucleare, Rome). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The pipe whip phenomenon consequent to a loss of coolant accident is studied by an ad hoc method and computer program. The following situation is studied: a pipe is accelerated by the fluid ejected after a LOCA and hits a restraint, located at a given distance from the pipe. The pipe is schematized by means of a series of lumped masses connected by springs: each spring and mass may be different from the others; each spring can have either an elastic or plastic behavior depending on the value of the applied loads, elastic unloading after plastic loading can be dealt with. The restraints are located at a given distance and act only after the pipe has travelled such an amount; an elastoplastic approach (with elastic unloading) is followed in this case, too. The applied LOCA load can be specified in a stepwise method. A direct step-by-step Euler-Gauss integration method is used. An evaluation of the pipe and restraints load capability is given on the basis of data published in the open literature on allowable strains in bars during dynamic loading and on instability moments on pipes. Typical cases are presented in which the pipe and restraints deformations are followed before, during and after the impact; the oscillating phase after maximum restraint deformation can be followed introducing appropriate damping. The program automatically gives displacements, moments and kinematics characteristics on a given temporary basis, maximum values and a comparison with the allowable values. 5 references. (auth)

12115 (CONF-730942-(P2), pp vp Sect. F6/1) THERMAL AND MECHANICAL ANALYSIS OF WELDED STRUCTURES. Nickell, R. E. (Brown Univ., Providence); Hibbitt, H. D. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

The prediction of the residual state of stress and deformation in a welded structure is one of the most interesting, challenging and complex problems in structural mechanics. Even if the prediction of the transient temperature field in the structure is assumed to be under control, determining the residual mechanical state is a difficult and expensive task. The analysis inevitably involves temperature-dependent mechanical properties and, in addition, the severe thermal gradients and high temperatures generic to the welding process induce irrecoverable inelastic creep and plasticity in the structure. In spite of this, the stress analysis is now considered to be a straight forward application for general-purpose, nonlinear finite element structural programs. A few special

features of such analyses, however, will be discussed: (1) the legitimacy of time-independent plasticity theories for treating the residual stress problem; (2) criteria for choosing plane stress, plane strain, generalized plane strain, or fully three-dimensional models; (3) methods for coping with possible floating regions (non-positive-definite stiffnesses) during cooling; and (4) the use of linear constraints to treat weld metal deposition and intermittent contact. 22 references. (auth)

12116 (CONF-730942-(P2), pp vp Sect. F6/4) COLLAPSE OF DUCTILE HEAT EXCHANGER TUBES WITH OVALITY UNDER EXTERNAL PRESSURE. Lohmeier, A. (Westinghouse Electric Corp., Tampa, FL); Small, N. C.; Bonin, H. J.; Gonnet, B. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Conventional rules in boiler and pressure vessel code documents for computation of collapse pressures of long circular tubes under external pressure do not directly give consideration to the reduction of external pressure capability due to tube cross section ovality. Allowable stress is based on computation of collapse pressure of perfect circular cylinders utilizing tangent modulus material behavior concept or empirical formulae based on collapse tests of actual tubes. Design rule safety factors have accounted for maximum ovality expected in actual tubing. In computation of external pressure of nuclear system heat exchange tubing, it is prudent to determine collapse pressure considering effects of ovality. Ovality can result from bending processes utilized in forming U-tube heat exchanger tubing, and an assessment should be made of the external pressure capability reduction in contrast to the increase due to the torodial shell form consequent from bending. An analytic technique has been devised for application to collapse pressure determination for long cylindrical tubes with uniform cross-sectional ovality using plastic limit analysis theory in computation of upper and lower bound limit pressure. The technique applies limit analysis theory to a geometric idealization of an oval tube where plastic material behavior governs the collapse mechanism rather than elastic instability. Theory includes the effect of elastic deformation changes on initial ovality prior to collapse. Yield criterion assumed is a bilinear representation of the parabolic yield surface consequent from the combination of bending and normal forces. In corroboration of the application of plastic limit analysis theory to collapse pressure determination of long, oval cylindrical tubes, collapse tests of actual heat exchanger tubing from several sources have been performed. Careful experiments have been performed for yield strength determination of sample tube specimens. Results indicate reasonable agreement with theoretical determination of collapse pressure using plastic limit analysis theory for tubes of diameter to thickness proportions conducive to plastic hinge formation collapse mechanisms. Collapse experiments with U-bend tubing indicate the increase in external pressure capability of sharply bent tubing over that of long straight cylindrical tubes with similar ovality. 10 references. (auth)

12117 (CONF-730942-(P2), pp vp Sect. F6/8) ORTHOTROPIC ANALYSIS OF A THICK PERFORATED PLATE WITH PRESSURE ON ONE SIDE. Slot, T. (Teledyne Materials Research Co., Waltham, MA). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

It is current practice in perforated plate design to use an equivalent solid plate approach in the analysis of stresses and displacements. With this approach the perforated material is replaced by a solid material with modified elastic constants, called effective elastic constants. The concept involved is based on the ability to derive these constants in such a way that gross displacements in the equivalent solid plate are the same as in the perforated plate when subjected to the same loading. The practical value of the equivalent solid plate method is that in addition to displacements it furnishes nominal stresses from which physically meaningful stresses can be determined for the perforated plate by means of suitable stress multipliers. This generalized method is based on treating the equivalent solid plate as an orthotropic solid and computing three-dimensional stress distributions for both the equivalent solid plate and the perforated plate. An isotropic analysis can lead to inaccurate results when used indiscriminately for solving thick perforated plate problems. The example pertains to a built-in, circular perforated plate that is subjected to pressure on one face. The diameter is five times the thickness and the perforation pattern is assumed to be of the triangular type with a ligament efficiency of 0.2. Two axisymmetric finite-element solutions are reported for the equivalent solid plate problem, the first based on orthotropic effective elastic constants, the second based on isotropic effective elastic constants. The results pressented show that the isotropic sclution over estimates the center deflection of the plate by a substantial margin. That is, the center deflection predicted by the isotropic analysis is thirty percent larger than the center deflection predicted by the orthotropic analysis. 8 references. (auth)

12118 (CONF-730942-(P2), pp vp Sect. F6/9) USE OF ORTHOTROPIC YIELD SURFACES TO OBTAIN LIMIT LOADS FOR PERFORATED PLATES. Sawczuk, A. (Inst. of Fundamental Problems of Tech., Warsaw); O'Donnell, W. J.; Porowski, J. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

Uniformly loaded circular plates having orthotropic, plastic properties are investigated. Limit pressure solutions are obtained for both the simply supported and rigidly built-in edge conditions. The usual sandwich plate theory is used. Statically admissible radial and circumferential bending moment fields are found for all annular regions of the plates, and the associated velocity fields are shown to be kinematically admissible. Numerical results are given in dimensionless form covering arbitrary plate geometries over the entire range of material orthotropy. These solutions are quite useful in the plastic design and analysis of perforated plates used as pressure vessel heads, tube sheets, reactor core support plates and the like. Perforated plates have considerably higher effective yield strengths when subjected to equi-biaxial loading than when subjected to loading of arbitrary biaxiality and orientation with respect to the penetration pattern. Thus, the equivalent orthotropic plastic material concept is ideally suited to the analysis of such plates. The resulting limit load pressures are substantially lower than the values obtained using isotropic Tresca yield properties based on the yield strengths or equi-biaxial loading. The results are substantially higher than the values obtained using the maximum isotropic Tresca yield properties falling entirely within the orthotropic yield surface. 7 references. (auth)

12119 (CONF-730942-(P2), pp vp 1p.) ENERGY ABSORBING RESTRAINT DESIGN AND ANALYSIS METHODS FOR PIPE RUPTURE LOADINGS IN NUCLEAR POWER PLANTS. Patrick, W. L. (Westinghouse Electric Corp., Pittsburgh); Truitt, J. B.; Schmidt, W. A. 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12120 (CONF-730942-(P2), pp vp 1p.) PROTECTION AGAINST DYNAMIC EFFECTS ASSOCIATED WITH PIPE WHIP. Rigamonti, G.; Dainora, J. (United Engineers and Constructors Inc., Philadelphia). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12121 (CONF-730942-(P2), pp vp 1p.) INELASTIC ANALYSIS OF A REACTOR PIPING SYSTEM. Chang, T. Y.; Khaitan, P. K. (Akron Univ., OH). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12122 (CONF-730942-(P2), pp vp 1p.) PROBLEMS OCCURRING IN NUCLEAR PIPING SYSTEM ANALYSIS AND OPERATION. Landers, F. G. (Univ. of Tennessee, Knoxville). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12123 (CONF-730942-(P2), pp vp 1p.) CONVENIENT METHOD OF MEASURING THE PLASTIC STRESS IN A BAR UNDER IMPULSIVE FORCES. Hayashi, T.; Fujimura, Y. (Osaka Univ., Toyonaka, Japan). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12124 (CONF-730942-(P2), pp vp 1p.) COMBINED ANALYSIS AND EVALUATION OF PIPING SYSTEMS USING THE COMPUTER. Watwood, V. B.; Chow, T. Y. (Franklin Inst. Research Labs., Philadelphia). 1973.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

12125 (EURFNR-1118) NEW DEFINITION OF RELIABILITY, CONTINUOUS LIFETIME PREDICTION, AND LEARNING PROCESSES. Caldarola, L. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Systemtechnik und Reaktorphysik). Jul 1973. 65p. (KFK-1847; EUR-4969; CONF-730714-2). Dep. NTIS (U. S. Sales Only) $5.25.

From generic techniques in systems reliability assessment conference; Liverpool, UK (16 Jul 1973).

Work performed under United States–Euratom fast reactor exchange program.

Various methods to improve the reliability of redundant systems are discussed. It is demonstrated that the additional benefit obtained by adding a redundant component to a system decreases

with the total number of components. It is shown that if one is able to predict with high precision the time of failure of each component, the main time to failure of the system may be significantly improved by replacing (or repairing) the components before they fail (preventative maintenance). A general theory of the reliability of a device as a function of its characteristics, past history, and expected operating conditions is introduced, which leads to a new definition of the concept of reliability. The concept of "continuous lifetime prediction" (CLP) based on this comprehensive theory is introduced and its basic principles are discussed. The method of CLP consists in recording during operation of a device the stresses applied to it, in monitoring any useful and significant quantity (for instance vibrations, noise etc.), and in processing these data and those obtained from eventual tests of the device (during its operation and during its downtime) to predict continuously (or at regular time intervals) the remaining lifetime of the device. It is demonstrated that this technique would significantly improve the reliability and availability of devices and systems by making preventative maintenance more effective, as well as giving the benefit of greater knowledge. Finally the adoption of the CLP method on a large scale gives the possibility of organizing learning processes where the knowledge of the manufacturer and user of a given device merge together. In these processes, which may be called "integrated learning processes", the data are produced in the user's plant and in the laboratory for lifetests and are stored and processed in a computer. (GE)

12126 (INIS-mf-125) DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR LIGHT WATER REACTOR PRESSURE VESSELS. Becka, J.; Brumovsky, M.; Indra, J.; Stepanek, S. (Ceska Vedeckotechnicka Spolecnost, Prague (Czechoslovakia). Komise pro Jadernou Techniku; Slovenska Vedeckotechnicka Spolocnost, Bratislava (Czechoslovakia). Komisia pre Jadrovu Techniku; Ceskoslovenska Komise pro Atomovou Energii, Prague). [nd]. 13p. (In Czech). (CONF-701214-12). INIS.

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The current status of pressure vessels for light water reactors in the world is reviewed. The differences in design, material, and technology between the American and the Soviet concepts are shown, and the preconditions are summed up for the manufacture of such vessels in Czechoslovakia. (INIS)

12127 (INIS-mf-804) DEVELOPMENT OF NUCLEAR JOBS MANUFACTURE IN WALCHANDNAGAR INDUSTRIES LTD., WALCHANDNAGAR. Mukherji, J. P.; Mukherji, K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 8p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A brief account of the technical and organizational challenge that industries engaged in the manufacture of conventional equipment have to encounter in the manufacture of sophisticated equipment required for nuclear industry is given. The Walchandnagar Industries in Poona, India, have successfully overcome the problems, and starting from jobs like thermal shield plates, even sophisticated jobs like fabricating the dump tank and fuelling machine head required for the Rajasthan Atomic Power Project Unit - 2, etc. have been satisfactorily completed. The short arc process using a modified mixture of gases has been developed for welding 1½" thick 304 L stainless steel to the fuelling machine head. Certain processes like "solution annealing" have been eliminated. It is suggested that coastal regions are best suited for the fabrication of nuclear equipment, in as much as transportation problems will be minimized. (INIS)

12128 (INIS-mf-807) IMPORTANCE OF METALLURGICAL QUALITY EVALUATION OF COMPONENTS. Ghate, M. S.; Balaramamoorthy, K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 9p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The role played by metallurgical evaluation in fabrication of reactor components such as end fittings and accessories, central cylinders of dump tanks and some components of dump port boxes is presented. End fittings are considered as an ideal example for emphasizing the role of metallurgical evaluation and their chemical composition and fabrication are discussed in detail. Nondestructive tests and mechanical tests like tension, hardness and impact tests are carried out on these end fittings. Ultrasonic inspection is done for the detection of longitudinally and circumferentially oriented flaws. Evaluation procedures followed for anti-torque collar and journal rings are reported in brief. (INIS)

12129 (INIS-mf-808) DESIGN AND FABRICATION OF REACTOR COMPONENTS: WELDING. Vannan, K. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Common problems that are encountered during the welding of reactor components and the measures to be taken to tackle these problems are examined. Consumable insert welding, weld edge preparation, preheat, interpass temperature control, weld distortion, post weld heat treatment, distortion control, electrode storage, non-destructive testing requirements, socket welding, and welding of stainless steel types AISI 347, 309 and 310 are discussed briefly. Suggestions for the development activities to be undertaken are given. (INIS)

12130 (INIS-mf-809) DESIGN AND FABRICATION OF REACTOR COMPONENTS: GENERAL. Vannan, K. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The problems encountered during the design, fabrication, and installation of reactor components and the remedial measures undertaken are reported. The topics studied include: impact test requirements for steel materials, limitation of chloride, sulphur, lead, cobalt and manganese in reactor components, crevice corrosion, effect of cold work on stainless steel material, design problems in RAPP-1 main airlocks, field erection problems, and import substitution deficiencies of Indian markets and shops. (INIS)

12131 (INIS-mf-813) NUCLEAR POWER PLANT WELDING. Rawal, R. C. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The experience of piping and welding at the Rajasthan Atomic Power Plant is described. The quality control, plans, various inspection reports for welded joints, pipe line check sheets, welder performance records, and system completion reports are explained. The tungsten inert gas welding process and the reasons for its selection are highlighted. The analysis of welding consumables, liquid penetrants, cleaning agents, marking paints, washing detergents, etc. to avoid harmful effects of ingredients on the welds and parent materials is mentioned. (INIS)

12132 (INIS-mf-816) USE OF HIGH STRENGTH FRICTION GRIP BOLTS FOR NUCLEAR POWER PROJECTS. Shangari, S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 16p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A brief outline is given of the design aspect of high strength friction grip bolts, their installation and subsequent inspection procedure. This being a new technique in India, the problems faced and their solutions during various stages of erection have been dealt with. (auth)

12133 (INIS-mf-859) RELIABILITY OF ELECTRICAL POWER SUPPLIES TO NUCLEAR POWER STATION AUXILIARIES. Tewari, P. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 7p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The need for reliability, classification of power requirements, and provision of reliability in nuclear power station design, equipment selection, and erection aspects is discussed briefly. Relevant data on operation and maintenance experience of existing nuclear power stations in India giving actual auxiliary power requirement, outage frequency, and duration, and equipment failures, would be of immense value for the design of the electrical system and equipment selection, in order to achieve the desired degree of reliability for the auxiliary power for the future nuclear power stations in the country. (auth)

12134 (SGAE-2171) THEORETICAL MODEL FOR THE DYNAMICS OF THE VOEST STEAM LOOP AT THE SEIBERSDORF RESEARCH CENTER. Brueder, H.; Nevyjel, A. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Sep 1973. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

A mathematical model is presented for the steam loop in the secondary cooling system for a reactor. The stationary solutions are calculated and the stability behavior is investigated by the method of small excursions for a wide range of 4 parameters. (auth)

12135 (TID-26498) ENGINEERING ASPECTS OF HEAT DISSIPATION IN WATER BODIES. Ryan, P. J. (Oak Ridge National Lab., Tenn. (USA)). 1973. 45p. Dep. NTIS $4.25.

A comparison is presented of the different types of waste heat disposal systems for nuclear power plants. The systems described include: once-through cooling with surface jet, submerged jet, and multiport diffuser; and closed-cycle cooling with

cooling towers, spray canals, and cooling ponds. (31 references) (DCC)

12136 APPARATUS FOR DETECTING REACTOR FUEL TUBE FAILURES. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,762,993. 2 Oct 1973. Filed Date 24 Jun 1971. 6p.

Apparatus for detecting reactor fuel element failures within an assembly of fuel elements is described in which a sampling device with a test chamber is disposed over an assembly of sealed fuel elements after a nuclear power plant has been shut down and preparation for fuel removal has been completed. Air is conducted through the sampling device to displace the coolant, such as water, in the test chamber above the assembly of fuel elements and to inhibit the circulation of the coolant about the assemblies of fuel elements. As a consequence thereof, the fuel elements of an assembly of fuel elements become heated and fission products are emitted from the defective fuel elements to cause an increase of radio-activity in the water about the assembly of fuel elements. Coolant within or about the assembly of fuel elements is then removed by the sampling device and conducted to a sampling station. At the sampling station is a vial containing a chemical to concentrate the fission products such as an iodine getter, which is exposed to the coolant conducted to the sampling station. The vials containing sample coolant concentrate are moved from the sampling station to a gamma scanner. The gamma scanner senses the activity level of the selected isotope contained in the coolant sample, which is used for detecting the failure of fuel elements within an assembly of fuel elements. (Official Gazette)

12137 EXPERIENCE IN THE BUILDING AND OPERATION OF SPRING SUPPORTED TURBINE GENERATORS IN NUCLEAR POWER PLANTS. Klotz, H. (Energie-Versorgung Schwaben AG, Stuttgart). pp 28-32 of VGB-bautagung Dortmund 1972. Essen; Vereinigung der Grosskraftwerksbetreiber eV (1972). (In German).

From VGB conference on construction technique in thermal power plants; Dortmund, Germany (27 Sep 1972).

Constructional and operational experience on the equipment and assembly of large springs and spring-supported turbine generators in German nuclear power plants is reported. In particular, the type of pre-stressing is dealt with and the vibrational behavior is described. (GE)

12138 TECHNOLOGY IN SODIUM: SOME UNSOLVED PROBLEMS. Elie, X.; Jacquelin, R.; Chouard, P.; Duquesne, J. C. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 182, 53-59(Jun 1973). (In French).

Some studies and tests must be completed or undertaken to obtain a better knowledge of the material technology of sodium in order to allow greater freedom in designing reactor components. Tests concerning mechanisms must be multiplied either at an elementary stage or at the stage of components; fundamental tests in the field of friction, cavitation, or frozen sodium seals have to be developed. (FR)

12139 DEVICE FOR TESTING FISSILE SUBSTANCE ELEMENTS IN A RESEARCH NUCLEAR REACTOR. Haefner, H.; Bojarsky, E. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,564,001. 22 Jan 1970. Filed Date 6 May 1966. (In German).

12140 INPILE CREEP TEST FACILITY FOR THE POWER REACTOR AND NUCLEAR FUEL DEVELOPMENT CORPORATION OF JAPAN. Ishikawajima-Harima Giho; 13: No. 4, 520-527(Jul 1973). (In Japanese).

This test facility was constructed and delivered to the customer in October 1972 for the purpose of investigating the creep properties of the zirconium alloy to be used in the Advanced Thermal Reactor, developed by the Power Reactor and Nuclear Fuel Development Corporation of Japan. This pressure tube is the first Japanese product fabricated by welding zirconium alloys, pursuant to the govermental regulation and for IHI was an invaluable experience. In particular the technical know-how concerning the welding of the pressure tube was established by the research and development on the welding of zirconium alloys. To date, the facility has been operating smoothly. The outline of the design, fabrication and performance tests of the test facility is presented. (auth)

12141 PRESSURE SUPPRESSION SYSTEM FOR A NUCLEAR REACTOR SAFETY VESSEL. Ulirich, W.; Lohse, K. H.; Leuteritz, J.; Zeitzschel, G.; Fassl, R. (to Licentia Patent Verwaltungs GmbH). German Patent 1,802,940. 18 Jun 1970. Filed date 14 Oct 1968. (In German).

A pressure suppression system for a safety vessel is described. It consists of a pressure enclosure of steel or concrete for a liquid-cooled nuclear reactor with a condensation chamber with toroidal floor (flooring, platform, ceiling) in the form of a circular cylinder in the interior of which parallel to the axis, not filling the entire cylinder, is found the pressure reservoir with a biological shield. The upper toroidal platform is crossed by the condensation pipes reaching the water, characterized by the following combination of characteristics: for the protection of walls subjected to pressure, a concrete casing is provided; the toroidal platforms are provided with pressure crossbeams; and the lower part of the condensation tubes is provided with a mooring where the sheet metal baffle plates are fastened. (TSS)

12142 PROCESS AND DEVICE FOR OPERATING A PRESSURE VESSEL UNDER HIGH INTERNAL PRESSURES. Muehlhaeuser, O. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,542, 186. 26 Mar 1970. Filed date 9 Sep 1966. (In German).

A device is described for operating a pressure vessel under high internal pressures with several compartments with different pressures. The device is characterized by the fact that the different intermediate pressures between the enclosures are maintained constantly at a given value with respect to the variable internal pressure. The purpose of the invention is to avoid a wall of the reservoir (for example of prestressed concrete) being subjected to too-high pressure as a result of a sudden pressure drop (for example, due to a breakdown). (TSS)

12143 REACTOR VESSEL. Ritz, L. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,639,289. 11 Feb 1971. Filed date 27 Feb 1968. (In German).

The vessel is composed of a prestressed concrete body to withstand pressure and an inside vessel protecting the concrete body from the harmful effects of the material of the tank; this envelope does not withstand the internal pressure of the tank, this being transferred to a liquid filling placed between the vessel and the concrete body. The protective vessel with its liquid filling extends outside the core chamber of the reactor by an evaporation chamber separated from the first by a part of the concrete body and arranged in concentric rings with respect to it. It has a section in the form of a wheel, the middle portion being the core chamber, the rim being the evaporation chamber, and the spokes, the channels linking the two chambers. (TSS)

12144 THERMIONIC NUCLEAR REACTOR WITH A CONNECTION IN SERIES OF THERMIONIC DIODES. Peehs, M.; Jung, W. (to Siemens AG). German Patent 1,614,417. 20 Aug 1970. Filed date 2 Feb 1967. (In German).

A nuclear reactor is described with thermionic diodes connected in series with the cathodes electrically isolated between them and coaxially surrounded by anodes enclosing the nuclear fuel. One of the advantages of this invention consists in the fact that all of the thermionic diodes of one series are ventilated by a single tube for fission gas, the electrical connection isolated between two neighboring cathodes being so tightly sealed with respect to vacuum that these connections, perforated longitudinally, can serve as a tube for the fission gas. (TSS)

12145 EMITTING SUBSTANCE FOR THERMIONIC CONVERTER. Peehs, M. (to Siemens AG). German Patent 1,564, 731. 19 Mar 1970. Filed date 30 Sep 1966. (In German).

The emitting substance for thermionic converters with a nuclear fuel in the interior and at one side some empty spaces open for the escape of gaseous fission products is characterized by the fact that a small perforated metal plate is mounted in the wall of a collection chamber connected by a drawing-off tube for the fission gases. This plate is provided with a perforated membrane slowing down the speed of the gas current between the position of the fission gas exit and the drawing-off tube of the same material as the emitting substance. (TSS)

12146 DEVICE FOR THE SELECTIVE EXTRACTION OF CERTAIN SPHERICAL ELEMENTS OUT OF A PLURALITY OF FEEDING TUBES CONTAINING DIFFERENT SORTS OF SPHERICAL ELEMENTS. Schening, J.; Landwehr, H.; Handel, H.; Becj, W. (to Brown Boveri Krupp Reaktorbau GmbH). German Patent 1,548,185. 16 Apr 1970. Filed date 15 Nov 1966. (In German).

The advantage of the device applicable essentially in the field of nuclear reactors consists of a collector for different sorts of spherical elements and a device for the separation of the elements, which provides a large reduction in the space occupied. (TSS)

12147 THERMIONIC CONVERTER. Janner, K.; Peehs, N.; Jung, W. (to Siemens AG). German Patent 1,614,419. 20 Aug 1970. Filed date 4 Feb 1967. (In German).

A converter of which the cathode contains some nuclear fuel and consists of devices for the issuance of dissociation gases issuing from the fuel chamber is characterized by a tube provided for the dissociation gas. (TSS)

12148 MEAN TEMPERATURE DIFFERENCE OF MULTI-CHANNEL HEAT EXCHANGERS. Ivanova, N. V.; Kanevets, G. E. (Inst. of Gas, Kiev). Inzh.-Fiz. Zh.; 25: No. 3, 504-513(Sep 1973). (In Russian).

Consideration is given to a heat transfer process in heat exchangers with one flow channel rejecting heat and n flow channels absorbing heat. To calculate mean temperature difference transcendental equations are given which can be solved on an electronic digital computer. For more simple calculation of the mean temperature difference graphs of the correction factor are presented for heat exchangers with odd number of tube channels. (9 references) (auth)

12149 PNEUMATIC CAPSULE FOR IRRADIATION DEVICES IN NUCLEAR REACTORS AND NEUTRON GENERATORS. Dieck, L. E. (to Kernforschungsanlage Juelich GmbH). German Patent 1,909,382. 21 Jan 1971 Filed date 25 Feb 1969. (In German).

The pneumatic capsule with a cover that can be put in place or screwed on is characterized by the fact that the capsule and cover are made of metal and that a plug of known and elastic material, such as metal or plastic, is arranged on the two extremities of the capsule. (TSS)

12150 BOND OF LINER AND PENETRATIONS TO THE CONCRETE IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Huber, G. (Zentralinstitut fuer Forschung und Entwicklung, Essen). Tech. Mitt. Krupp, Forschungsber.; 31: No. 3, 125-132(1973). (In German).

From second international conference on "structural mechanics in reactor technology"; Berlin, Germany (10 Sep 1973).

A description is given of the interaction of theoretical results obtained for the prestressed concrete pressure vessel, the liner and the penetrations. The special structural requirements resulting from the need of providing a firm bond are explained by an example. Moreover, some suggestions are given relating to a new design. (GE)

12151 NUCLEAR FUEL ELEMENT WITH STRENGTHENING DURING SHIPMENT. Rogell, M. L. (to United Nuclear Corp.). US Patent 3,770,582. 6 Nov 1973. Filed date 4 Nov 1971. 6p.

The nuclear fuel element has an array of parallel fuel tubes or rods arranged in parallel rows. Rigid bars having opposing semi-circular formations or scallops on their opposite edges are placed between alternate pairs of rows of the tubes, advantageously in two directions at right angles to each other. The thickness of these bars is made substantially less than the water channel spacing between the rows of tubes and both edges of these scallops are chamfered. These two factors render the tube supports or bars easily insertable prior to shipment and easily removable later on. (Official Gazette)

12152 APPARATUS FOR DRYING STEAM IN NUCLEAR POWER STEAM GENERATORS PLANTS. Klein, H.; Pieper, R.; Hoffmann, A. (to Siemens Aktiegesellschaft). US Patent 3,769,781. 6 Nov 1973. Filed date 12 Oct 1971. 6p.

An apparatus for drying the steam of a steam-water mix generated by a steam generator is described which has an axial cyclone arranged above the steam generator for separating at least a portion of the water from the steam-water mix, for yielding separated water and a remaining steam-water mix, and for passing the water and the remaining mix in an upward direction. A plurality of counter-flow cyclones for receiving the separated water separated from the mix in the axial cyclone are also provided and each of the counter-flow cyclones has a wall defining a turbulence chamber, a tube extending into the chamber, and inlet guide vanes disposed concentric to the tube for imparting a spin motion to the separated water for separating the latter into water and clarified steam in the chamber. A tornado-flow separator for separating the remaining mix into additional water and clarified steam is disposed above and coaxial with the axial cyclone. The tornado-flow separator has a lower axial inlet for admitting the remaining mix as well as having an upper outlet for discharging clarified steam. The tornado-flow separator also has an upper auxiliary gas inlet coaxial with the upper outlet for admitting the clarified steam separated in the counter-flow cyclones. (Official Gazette)

12153 TRANSMITTERS FOR NUCLEAR PLANTS. Ai, M.; Yamamoto, Y.; Okayama, T.; Nagata, T. (Hitachi Ltd., Katsuta, Japan). Hitachi Hyoron; 55: No. 8, 844-848(Sep 1973). (In Japanese).

Hitachi, Ltd. has been manufacturing various types of detectors for nuclear power plants using light water reactors or fast breeder reactors, uranium enriching plants using centrifuge method or gaseous diffusion method, and radioactive waste treatment plants. Some unusual types are described including pressure transmitters for fast breeder reactor use, amplifiers for level transmitter, water leak detecting systems, and pressure transmitters for uranium enriching plant use. Among them the NaK filling type pressure transmitters have been in service since 1969 at the Power Reactor and Nuclear Fuel Development Corporation. The water leak detecting system is scheduled for delivery to the same corporation for use with a 50 MW steam generator. Also, 1 Torr absolute pressure transmitters are in use in the uranium enriching section. (auth)

12154 HEAT EXCHANGE INSTALLATION FOR A NUCLEAR REACTOR. Costes, D. (to Commissariat a l'Energie Atomique). French Patent 2,150,255. 26 Aug 1971. 10p. (In French).

An installation is described in which heat exchange occurs between the primary coolant of a nuclear reactor and a secondary coolant. The installation consists of an exchange array in which a primary fluid flows and is constructed in an elongated cavity provided in the pressure vessel, the secondary coolant flowing through this cavity. One of the ends of this cavity is connected to the outside by an orifice which can be closed giving access to the array. The primary coolant circuit includes a chamber provided in the vessel in the extension of the other end of the array. This chamber has a diameter smaller than that of the cavity and is connected to the collector of the array outlet by a pipe and to the reactor by a return duct. (FR)

12155 NEW ARRANGEMENT FOR A NUCLEAR PLANT STEAM TURBINE. (to Societe Creusot-Loire). French Patent 2,147,776. 27 May 1971. 11p. (In French).

A new arrangement for nuclear plant steam turbines is presented. In this new arrangement, the vapor is subjected to an initial expansion in high pressure single flux stages, passes into a dryer, and is then subjected to a second expansion in low pressure stages. The low pressure stages consist of two separate parts: a first single flux part in which the beginning of the second expansion takes place within the limits permitted by the size of the last blades; and a second multiflux part in which the end part of the expansion take place. (auth)

12156 IMPROVEMENTS TO THE HYDRAULIC CIRCUITS INSIDE REACTOR VESSELS. (to Societe Babcock-Atlantique). French Patent 2,137,138. 14 May 1971. 11p. (In French).

An original method is presented for manufacturing and assembling a skirting situated inside a reactor vessel and presenting passages for the flow of fluid from tubes of the reactor vessel and having joints ensuring (at least under particular regime conditions for the installation) a leaktight joint between the passages and the tubes. These joints are in the form of sleaves electronically welded to the skirting. (FR)

12157 END FITTING RETAINER FOR NUCLEAR FUEL ASSEMBLY. Winders, G. R. (to Nuclear Fuel Services, Inc.). US Patent 3,769,158. 30 Oct 1973. Filed date 24 Nov 1971. 6p.

A nuclear reactor core fuel assembly has upstanding support rods supporting an end fitting over the fuel rods. The support rods have reduced necks extending through openings in the end fitting with resilient split rings in grooves and engaging the end fitting. The rings may be flexed by a special tool for removal of the end fitting or may be flexed by the end fitting when lowered thereon. (Official Gazette)

12158 DEVICE FOR THE MECHANICAL SELECTION OF REACTOR MEASURING CANALS. Erkens, W. (to Licentia Patent-Verwaltungs-GmbH). US Patent 3,766,005. 16 Oct 1973. Priority date 22 May 1970, F. R. Germany. 4p.

A device is described which consists of a housing on which are attached a plurality of measuring canals arranged in a circle. Within the housing is a disc having a bore. The disc is mounted rotatably such that its bore may sweep over the various measuring canals arranged in the circle. The disc may be stopped for the registering of its bore with any one of the canals, whereby a selecting tube connected to the bore of the disc is placed in communication with a particular measuring canal for the introduction into the measuring canal of a sensor for taking measurements. The gap between disc and housing is sealed around the bore and measuring canals. (Official Gazette)

12159 METHOD OF INSERTING NUCLEAR FUEL RODS IN GRID ASSEMBLY. Bleiberg, M. L. (to Atlantic Richfield Co.). US Patent 3,757,403. 11 Sep 1973. Filed date 29 Apr 1971. 4p.

A method of inserting metal alloy clad nuclear fuel rods in a fuel rod spacer grid assembly without scratching the clad material is described. A hoarfrost-like coating on the rods is applied before inserting them in the assembly. (Official Gazette)

12160 CONFERENCE ON RECENT DEVELOPMENTS IN COMPACT HIGH DUTY HEAT EXCHANGERS, LONDON, ENGLAND, OCTOBER 12, 1972. London; Institution of Mechanical Engineers (1973). 115p.

Separate abstracts were prepared for 2 of the 11 papers included. The remaining papers are outside the scope of NSA. (JWR)

For abstracts of individual papers see: 12161 and 12162.

12161 DISCUSSION OF WATERSIDE CONDITIONS AFFECTING THE THERMAL PERFORMANCE OF SODIUM HEATED RECIRCULATING AND ONCE-THROUGH STEAM GENERATORS. Bolt, P. R.; Firman, E. C. pp 1-12 of Conference on Recent Developments in Compact High Duty Heat Exchangers. London; Institution of Mechanical Engineers (1973).

From conference on recent developments in compact high duty heat exchangers; London, England (12 Oct 1972).

The basic features of current designs of sodium heated steam generators are described and the incentive for a greater understanding of the waterside thermal transport processes is justified. The prime requirement for high boiler integrity is presented and the waterside conditions leading to a possible reduction in the integrity of steam generators is discussed. The performance requirements for operational steam generators in respect of thermal capability, limits of operation, control and response, stability, etc, are outlined and reference is made to conditions which can cause shortcomings in the required performance. The design actions which can be taken to minimize the effect on boiler performance of conditions such as waterside deposition, magnetite rippling, thermal dryout, steam entrainment, instability, transients and faults, and flow maldistribution are considered. Information is presented on relevant problems and faults that have occurred on existing nonnuclear and nuclear boilers together with the remedial actions that were taken. Experimental work undertaken on these topics is described together with the areas on which further data should be obtained. (auth)

12162 STEAM GENERATORS FOR NUCLEAR POWER PLANTS. Gilli, P. V.; Fritz, R.; Lippitsch, J. pp 13-22 of Conference on Recent Developments in Compact High Duty Heat Exchangers. London; Institution of Mechanical Engineers (1973).

From conference on recent developments in compact high duty heat exchangers; London, England (12 Oct 1972).

Steam generators for nuclear power plants are typical examples of modern high duty heat exchangers with stringent requirements on performance and reliability. Extreme compactness of the heat transfer surface is mandatory because of high unit performance and high operating pressures on both the heat transferring and the steam/water side. Availability of a nuclear power plant depends to a considerable extent on the steam generators, tube failures being a typical reason for steam generator down-time. The design and assessment of steam generators for existing and future reactor types are discussed. (auth)

Reactor Fuels

Refer also to abstracts 10579–10581, 10587, 10590, 10594, 10596, 10599, 10601, 10602, 10609, 10611, 10623, 10664, 10667, and 10700.

12163 (CEA-CONF-2422) IRRADIATION OF FUELS WITH DENSITY OF 80 AND 85% IN RAPSODIE. Carteret, Y.; Conte, M.; Trotabas, M.; Kryger, B.; Lallement, R.; Ratier, J. L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1972. 39p. (In French). CONF-730726-5). Dep. NTIS (U. S. Sales Only) $4.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

The use of low-density mixed oxide in order to obtain both a high specific power and the accommodation of the swelling due to fission products was tested by the irradiation of fuel pins containing mixed oxides with density of 80 and 85%. The pins were jacketed in 316 stainless steel and Hastelloy X and irradiated to a burnup from 38,000 to 82,000 MWd/t. Of the 162 pins irradiated, only one lost its tightness. The observations showed a deformation, attributable for the most part to the swelling of the steel, but also to a plastic deformation (in the case of 316 stainless steel). The deformation was independent of the fuel density. In the fuel there was almost total disappearance of the porosity of the fuel even in the peripheral zone at high burn-up. There was a densification of the annular fuel. The densification of the fuel occurred with evacuation of the porosity toward the center and toward the periphery causing an increase of clearance and a general elevation of the temperature, either at the beginning or during the entire irradiation. The consequence of this last phenomenon is a high release rate of fission gases. The deterioration of the thermal transfer is accentuated by the swelling of the jackets. At 82,000 MWd/t, a radial distribution of the disturbed Pu was observed even at low linear power. The swelling of the oxide was evaluated for combustion rates of 10% as $7.8 < G < 10\%$. An oxide-jacket contact reaction was observed in which the thickness increases with the jacket temperature and with the irradiation rate. (tr-auth)

12164 (CEA-CONF-2425) IRRADIATION OF A BROKEN FUEL PIN IN A SODIUM LOOP. Hairion, J. P.; Cauvin, J. C.; Chenebault, P.; Delmas, R.; Lhermenier, A. (CEA Centre d'-Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). 24 Apr 1973. 22p. (In French). (CONF-730726-11). Dep. NTIS (U.S. Sales Only) $3.25.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

The fission gas signal emitted by a broken pin cooled by sodium circulation and the evolution of this signal when the irradiation is continued was studied. The pin contained the mixed oxide (U, Pu)O_2 and had a significant rupture at its upper portion at the beginning of the irradiation. The study showed that sodium very rapidly penetrates into the pin and creats a joint of good thermal conductivity. After about a month of irradiation, the total conductivity is reduced and a central funnel appears in all the fissile column. After about two months, local overheatings are produced at different levels and cause partial fusion of the fuel. The release of fission gas is not continuous; after long periods in which only the halogens migrate in the heat-carrying circuit; the gases are released in the form of very brief bubbles whose emission is probably connected to local interactions between the sodium and the hot fuel. During power drops, the sodium rapidly enters the pin and causes the expulsion of large quantities of gas. γ spectrometric analysis made several hours after irradiation shutdown on the sodium circuit and the fuel pin made it possible to effect the balance of the migration of a large number of radioactive nuclides. For iodides and Cs, the rates of release are coherent with observations made in Rapsodie that the migration kinetics favor the long-lived isotopes. In the fuel, a large number of nuclides are carried away and concentrated at the rupture level (Mo, Ru, and Nb). Local overheatings connected to the decrease of the thermal conductivity and to the formation of reaction products at the oxide/jacket interface cause the migration of stable isotopes (La). (tr-auth)

12165 (KFK-1835) ADVANTAGES AND DISADVANTAGES OF THYRISTORS AT THE POWER SUPPLY OF ELECTRICALLY HEATED RODS WITH HIGH POWER DENSITY. Krebs, L.; Malang, S.; Politzky, H. M.; Rust, K. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Oct 1973. 38p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Electrically heated rods are used to investigate the thermal conditions at fuel rods. Direct current systems as well as alternating current systems may be used as the power supply of such rods. More and more thyristors are applied since they are the simplest and cheapest means of regulating the power of heaters. However, in addition to the problems in measuring the power, the regulation by phase control or pulse train control causes mechanical stresses in the heaters due to the time dependent change of heat generation. The example of an indirectly electrically heated rod was used to investigate the mechanical effects of the phase control on the current conductor. (auth)

12166 (RD/B/N-2685) ENERGY CONSIDERATIONS OF INTERGRANULAR PORES AND THEIR RELEVANCE TO GAS RELEASE IN FUELS. Beere, W. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 14p. Dep. NTIS $3.00.

Liquid and gas phases penetrating down grain boundaries are discussed with reference to gas release in nuclear fuels. Energy criteria are derived for equilibrium-shaped gas bubbles, voids, and open pores. Lenticular bubbles on grain boundaries and interlinked grain edge bubbles are treated in detail. It is shown that equilibrium shaped pores have a constant surface curvature. The dihedral angle at the intersection of surface and grain boundary is independent of any gas pressure and maintains an equilibrium of tensions. A simplified model is constructed of porosity penetrating down grain boundaries. The model demonstrates the stable configurations and the porosity level at the onset of collapse of the interconnections between pores. At a sufficiently high porosity level, the interconnected pores are capable of forming extensive penetration reaching the exterior surface of fuel pellets. (auth)

12167 FABRICATION OF FUEL RODS FOR NUCLEAR REACTORS. Ruckdeschel, W. (to Linde AG). German Patent 1,814,626. 10 Sep 1970. Filed date 13 Dec 1968. (In German).

A process is described for the fabrication of fuel rods for nuclear reactors in which the nuclear fuel is introduced into a jacket closed on one end by a welded plug and finally closed by means of another sealed plug in such a manner that it is gas-tight. The bands of solder that join the end plugs to the jacket are introduced by means of a plasma or microplasma process. (TSS)

12168 CNEN'S EXPERTISE ON THE NUCLEAR FUEL CYCLE. Schileo, G. (CNEN, Rome). Nucl. Eng. Int.; 18: No. 209, 795-797(Oct 1973).

A brief review is given of the research and development work of CNEN, and the experience gained in the various phases of the nuclear fuel cycle. Reference is made to U ore prospecting, ^{235}U enrichment, and U and Pu fuel fabrication. (UK)

12169 FAILED FUEL LOCATING. Flemons, R. S. (to Canadian General Electric Co. Ltd.). Canadian Patent 912,712. 17 Oct 1972.

A method for the location of failed fuel elements by detecting the presence of radioactive fission products in the coolant of a nuclear reactor and a device for this purpose are described. A sample chamber is connected to each reactor pressure tube with tubing sized to give a continuous flow of coolant through each sample chamber and a delay time of about 45 seconds. Neutron detectors are inserted into the sample chambers by reducing the air pressure which normally suspends detectors above the sample chambers. The detectors contain neutron sensitive targets of fissionable material such as ^{235}U and solid-state nuclear track detecting material. Exposure of the detector to radiation is limited to the time when a burst of neutron emitting products released from a defected fuel element by a power cycle will be present in the coolant in the corresponding sample chambers. Residence time in the sample chamber cavity is normally 1–5 minutes. Air pressure is increased to return detectors to their rest positions and the detectors are then examined for track damage. (CA)

12170 BIRTH, ABUNDANCE, AND MOVEMENT OF FISSION PRODUCTS THROUGH FUEL. Findlay, J. R. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 415-419(Oct 1973).

In a brief review of fission product generation and movement in reactor fuels the following aspects are discussed: steps to be evaluated in assessing the influence of fission products on fuel performance; methods of calculating fissile atom concentrations; determination of yields, with reference also to published yield compilations; and processes involved in the migration of long-lived and stable fission products. In considering the behavior of short-lived fission products, which become important where fission products may be released to the reactor circuit, particular reference is made to the release of ^{85m}Kr from $(U,Pu)O_2$ fuel. (UK)

12171 NUCLEAR FUEL ELEMENT. Stoll, W. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,589,855. 16 Jul 1970. Filed Date 10 Oct 1967. (In German).

12172 SPACER FOR FUEL ELEMENTS OF A WATER-COOLED REACTOR. Christ, R. (to Nuklear Chemie and Metallurgie GmbH). German Patent 1,813,878. 9 Jul 1970. Filed Date 11 Dec 1968. (In German).

Spacers for the fuel elements of a water-cooled nuclear reactor are characterized by the fact that the fuel rods maintain their distance because of a system of spring clamps and vaultings with which the lattice is provided. In the interior of the aperture are found respectively one or some vaults facing a spring clamp parallel to the axis of the fuel rod and on two planes. (TSS)

12173 PROCESS FOR REDUCING THE SPACE BETWEEN THE CAN AND FUEL IN NUCLEAR REACTORS. Scharf, H.; Poplat, G. (to Siemens AG). German Patent 1,614,657. 26 Nov 1970. Filed Date 22 Nov 1967. (In German).

12174 PROCESS FOR THE EARLY DETECTION OF LOCAL OVERHEATING OF FUEL ELEMENTS IN SODIUM NUCLEAR REACTORS. Schmidt, K. (to Internationale Atomreaktorbau). German Patent 1,917,590. 15 Oct 1970. Filed Date 5 Apr 1969. (In German).

A process is described for precise detection of local superheating of fuel elements in a sodium-cooled nuclear reactor. The numerous currents of coolant coming from parallel channels are collected, and their temperature is measured with at least a thermoelement. When the noise level of the thermoelement exceeds its normal value, a signal is released. (TSS)

12175 FUEL ELEMENT RODS FOR NUCLEAR REACTORS. Schneider, G. (to Nuclear Chemie and Metallurgie GmbH). German Patent 1,614,308. 9 Jul 1970. Filed Date 13 Dec 1967. (In German).

12176 MEASUREMENT OF FISSION GAS RELEASE RATES FROM A URANIUM DIOXIDE FUEL PIN DURING IRRADIATION IN A FAST REACTOR. Bremner, W. B.; Washington, A. B. G. (United Kingdom Atomic Energy Authority, Dounreay, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 4, 449-454(Oct 1973).

An experiment carried out in the Dounreay fast reactor to measure continuously the fission gases released from a long uranium dioxide fuel pin irradiated to a burn-up of 2% is described. The gases were swept by a helium purge from the pin to the reactor top where they were analyzed by bottle sampling and in line gamma spectrometry. Measured release rates increased with isotopic half life from about 0.03% for ^{89}Kr (half life 3.2 min) to 60% for stable gases. Although the release rates varied throughout the irradiation they did not increase significantly with rapid changes in reactor power. (auth)

12177 SUPPORTING ELEMENT FOR FUEL ELEMENTS. Grahmann, B. (to Siemens AG). German Patent 1,639,396. 25 Feb 1971. Filed date 27 Jan 1968. (In German).

The device is characterized by a guiding framework for the fuel elements, being fitted with lateral catches that can be placed on the fuel elements by means of a telescopic clamp at the same time that one head of the clamp, and by a support base opens laterally in the cooling installation for the lateral introduction of the fuel elements fitted with the guiding framework. (TSS)

12178 FUEL ELEMENT FOR NUCLEAR REACTORS. Schlenker, H. (to Licentia Patent Verwaltungs GmbH). German Patent 1,639,307. 25 Feb 1971. Filed date 27 Feb 1968. (In German).

This fuel element or fuel rods is arranged in bundles inside a container. It is characterized by the fact that the radially elastic tension rods are inserted into the fuel element at the location of several fuel rods. (TSS)

12179 EVOLUTION OF NUCLEAR FUELS. Boltz, C. L. Phys. Technol.; 4: No. 3, 223-239(1973).

The use of nuclear fission to produce electrical power belongs to less than two decades. In the period of about twenty years, Britain has spent some £500 million on research and development for nuclear power while world-wide the sum is more than £2000 million. About half of this has gone into the entirely new technology of nuclear fuel. The basic material is a uranium or plutonium isotope. ^{238}U and ^{235}U occur in natural uranium as produced from the ore in the proportion of 99.3 to 0.7. ^{233}U and ^{239}Pu are fissile but must be produced by neutron bombardment. A review of fission physics is given and the use of moderators, coolants, and reactor design factors considered. Early power reactors, Gas-Cooled Reactor Mk II, Heavy Water Reactors, GCR Mk III reactors, and fast reactors are all examined. (UK)

Reactor Control Systems

Refer also to abstract 10603.

12180 (ANL/EBR-68) EVALUATION OF EX-REACTOR LOADING EVENT ON HIGH-FLUENCE EBR-II CONTROL-ROD THIMBLE 5E3. Flinn, J. E.; Krajcinovic, D.; Phipps, R. D.; Franklin, D. G.; Miller, S. C. (Argonne National Lab., Ill. (USA); Argonne National Lab., Idaho Falls, Idaho (USA)). Feb 1973. Contract W-31-109-eng-38. 59p. Dep. NTIS $5.00.

A Type 304 stainless steel EBR-II control-rod thimble (CRT 5E3) with high fluence was damaged while undergoing dimensional evaluation. The damage, which occurred when the thimble was inadvertently loaded in a bending mode, consisted of rather localized but extensive fracture. An elastic stress analysis of the bending mode was done on the thimble, using semimembrane shell theory. The analysis disclosed several important aspects that the simpler and more commonly employed techniques do not disclose. The hoop stress was found to be the most probable to initiate failure in that crack initiation would most likely result from localized yielding from the hoop stress. Structural assessment of the failure with the aid of scanning electron, transmission electron, and optical microscopy qualitatively supported the stress analysis in that the failure was associated with localized yielding and was accompanied by some, but limited, ductility. There was no evidence that a premature failure occurred (e.g., a failure at stresses below the yield stress of the material and which might be associated with grain-boundary embrittlement). (auth)

12181 (CEA-CONF-2231) BALANCE OF STUDIES AND OF DEVELOPMENT OF COMPONENTS OF COMMAND CONTROL OF NUCLEAR POWER STATIONS. Perspective for a Medium Term. Furet, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 43p. (In French). (CONF-730108-6). Dep. NTIS (U.S. Sales Only) $4.25.

From symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

A brief review of the present industrial development of nuclear power stations on a world scale is given. The evolution of this development is analyzed with emphasis on the economy, effect of

size, and the results obtained. The role of control and instrumentation is examined with respect to economy, availability, use, operational safety, and fuel management and utilization. The evolution and perspectives are analyzed under the aspects of kinetics and dynamics of the reactor, possible contribution of modern control theories for the definition and exploitation of power stations, incidence of the use of numerical calculators in control equipment, importance of measurement instrumentation for the simultaneous control and diagnosis of operational defects, and flexibility of control ensembles. (JSR)

12182 (CONF-720613-P1, pp 277-283) CONTROL OF THE INCORE THERMIONIC REACTOR (ITR) BY MOVABLE REFLECTOR ELEMENTS. Bernnat, W. (Univ., Stuttgart). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

In the ITR the variations of reactivity due to the burn-up and poisoning by fission products, the hydrogen leakage, or the heating-up of the reactor will be compensated by burnable poisons and by reflector control elements. Furthermore the control elements will be used for the reactor power-regulation and shutdown. Two different reflector element designs were investigated. The first uses revolving reflector drums as in the SNAP concept. Here the control of the reactor is accomplished by varying leakage rates. The second uses rotating control-cylinders which are partly poisoned. Due to the position of the neutron absorber regions the reflector becomes more or less effective for neutrons having epithermal or thermal energy. For both the control drums and the control cylinders the reactivity and power distribution were calculated as a function of the reflector position. The calculations of the control drum worth were performed with the MONTE CARLO method, because of the very complex geometry of the reactor with its rotating reflector elements. Both analog and correlated Monte Carlo were used to estimate values for k_{eff} and its change Δk. The hereby applied estimation methods were tested by the simulation of several experiments which were done at the ITR critical facility at Jülich. (auth)

12183 (CONF-720613-P1, pp 285-293) FEEDBACK SYNTHESIS OF AN INCORE THERMIONIC REACTOR CONTROL SYSTEM FOR SPACE. Dagbjartsson, S.; Ferg, D.; Siegel, K. (Univ., Stuttgart). 1972.

From third international conference on thermionic electrical power generation; Juelich, Federal Republic of Germany (5 Jun 1972).

Results are described of an initial study investigating the feasibility of using multivariable state-feedback in the control system design for an orbiting incore-thermionic reactor. The design used existing multivariable decoupling techniques to form single input-output subsystems and then applied the well-known techniques of state-variable feedback to achieve desired subsystem responses. The desired subsystem responses were chosen by imposing a set of design constraints and by considering hypothetical perturbations arising from a loss of radiator surface area and a drop in coolant mass-flow-rate plus a command input requesting a change in the diode electrical current. Results of the control system design are illustrated with appropriate time responses. (auth)

12184 (INIS-mf-815) INSTRUMENTATION AND CONTROL FOR RAJASTHAN ATOMIC POWER PROJECT: CONSTRUCTION ASPECT. Rama Rao, V. V. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 6p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The construction aspects of instrumentation and control systems for Rajasthan Atomic Power Project are described. Total quantities of instruments, stainless steel tubing and fittings, copper tubing, cabling and junctions for RAPP-1 are given. The costs for equipment and installation are mentioned. All instruments are inspected, tested and calibrated before installation. Schedules of installation with respect to piping and other systems are discussed. Details of the large amount of documentation required for installation, problems of procuring and stocking all types of construction materials, and manpower requirement are explained. All areas of installation like stainless steel tubing, automatic tube welding, swagelok fittings, copper tubing, and MICC cabling are considered. (auth)

12185 (INIS-mf-853) INSTRUMENTATION AND CONTROL OF CANDU REACTORS. Prabhakar, B. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 27p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The instrumentation and control needs of a nuclear power plant can be broadly put into four categories: conventional plant control; reactor process control; neutron power control; and reactor safety devices and radiation control. While the first two of these are similar to what is used in conventional power plants, the others are special to nuclear plants. The variety of possible nuclear reactors is so large that the neutron power control and safety features have been very diverse. The CANDU type reactors have blazed a new trail in these aspects, carrying forward the original concepts employed in the NRX reactor. The use of heavy water as the process fluid has led to special development efforts in the instrumentation area. The BLW is a recent concept which has brought in new efforts in control and safety aspects of CANDU type reactors. The increased size of the recent CANDU type stations and the progress in the control technology has led to changes such as extensive computer control and in-core flux monitoring for control and has also resulted in the elimination of moderator dumping as a safety feature. The Indian nuclear power stations have generally followed the Canadian pattern, the main accent being placed on the indigenization program, with design changes being made towards increasing indigenous content. In RAPP-1, the instrumentation and control cost is about 5% of the total plant cost; the indigenous content is about 40% and is expected to reach 70% in the next reactor. The integration of nuclear plants into existing power systems needs careful planning. The CANDU type station has certain pecularities which may need careful load scheduling on the various generating plants in the power system. (auth)

12186 (INIS-mf-878) SAFETY AND CONTROL SYSTEMS OF THE PURNIMA REACTOR. Srinivasan, M.; Dharmadhikari, M.; Karkera, B. N.; Mahindroo, P. N.; Ray, A. K.; Seshadri, S. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

"PURNIMA", a zero energy fast reactor, is the latest addition to the family of reactors at Trombay. The extremely small mean prompt neutron life-time (l) and a low delayed neutron fraction (β_{eff}) of this concentrated Pu^{239} fuelled fast critical assembly demand quick-acting and highly efficient control and safety systems. The salient features of the control and safety system of this reactor are examined. The description includes, general requirements for safety and control systems, primary control signal, safety devices, control rods, and control logic. Greater emphasis has been placed on safety rather than reliability. Fail-safe methods have been adopted to the maximum possible extent. (INIS)

12187 (INIS-mf-880) DESIGN OF THE CENTRALISED DATA PROCESSING SYSTEM. Weling, S. A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

Considerations which influence the design of the system and the reasons for adopting a computer-based control system for Fast Breeder Test Reactor (FBTR) at Kalpakkam instead of a cheaper alternative such as a data logger system are discussed. The functions required to be carried out by the Centralized data processing system (CDPS) as user specifications for the safety and control of the plant are described. The functions are classified under the headings of (1) Safety, (2) Supervision, (3) Display of information, (4) Checklisting and sequencing of operations, (5) Management calculations, (6) Scientific calculation, (7) Data logging and (8) Future additions. The design philosophy in arriving at the chosen configuration starting from the user specifications is described. (auth)

12188 (INIS-mf-881) SOFT-WARE OF THE CENTRALISED DATA PROCESSING SYSTEM. Boopathy, C.; Chandrasekharan, A. V. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

The centralized data processing system of the Fast Breeder Test Reactor (FBTR) at Kalpakkam is designed to perform real time processing so that the result of processing can be used to guide the operator to control the plant. To perform the task of scanning and processing a Real–Time Software String (RTSS) has been designed. The different programs that constitute RTTS viz., (i) initialization program of analog scanning system, (ii) peripheral interrogation program, (iii) sub-program of core temperature supervision (SPCS), (iv) sub-program of general supervision, (v) sub-program of discordance supervision (SPDS), (vi) sub-program of trip circuit supervision (SPTS), (vii) computation programs, (viii) post-analysis programs, (ix) diagnostic programs are briefly explained. The software design approach for some of the more important sub-programs which fulfil the functions of safety, control and the man machine communications is presented. (INIS)

12189 (INIS-mf-884) SAFETY LOGIC SYSTEM OF THE FAST BREEDER TEST REACTOR. Sangodkar, D. B.; Muralikrishna, G.; Paziaud, A. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 15p. INIS.

Safety logic system of the Fast Breeder Test Reactor (FBTR) at Kalpakkam provides for a scram (dropping of all the control rods under gravity) a set-back in power (partial lowering of rods) or a gradual lowering to shut down of all the control rods. Various measures (parameters) and incidents leading to a safety action are described. A two-out-of-three logic is adopted which is automatically converted to a one-out-of-two logic on failure of one of the redundant channels. Physical redundance and geographic and power source independence of the inputs are described. The logic hard-ware is solid-state (RTL). Since solid state logic design is not absolutely fail-safe, an on-line fine impulse test has been introduced for early detection of unsafe as well as safe faults developing in the logic. The test consists of injecting short trip signals sequentially at all the scram inputs and verifying the good propogation of these signals up to the power gates. The test system consists of a generator, a modulator, an address block and decoding matrix and a fault detection block. It is expected that the fault will be repaired at the subsequent reactor shutdown. (INIS)

12190 DRIVE ASSEMBLY FOR NUCLEAR REACTOR CONTROL RODS. Kuenzel, H. (to Siemens Aktiengesellschaft). US Patent 3,762,994. 2 Oct 1973. Priority Date 10 Dec 1969, F. R. Germany. 4p.

A drive assembly for inserting and removing the control rod of a nuclear reactor is described which has a guide tube arranged outside the reactor and a drive rod connectable to the control rod. The drive rod is movable within the tube between raised and lowered positions and a holding device is provided for holding the drive rod in a raised position. A spring surrounding the drive rod is compressed when the lifting device holds the drive rod in the raised position. The shock absorber disposed at the lower region of the guide tube receives the impact of the spring when the drive rod is released by the holding device. (Official Gazette)

12191 TRANSIENT ANALYSIS OF FAST REACTOR POWER PLANTS. Aoki, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Nippon Genshiryoku Gakkaishi; 15: No. 5, 332-337 (May 1973). (In Japanese).

The transient analysis of a fast reactor power generating station with once-through type steam generator and with the design of the plant control system is presented. The feature of the analytical model is a one-dimensional distributed parameter model of the steam generator. The validity of the model is examined by a calculation of the pump failure transient of the secondary sodium flow. This is followed by a study of three kinds of partial load operation characteristics. The possibility of feed-forward control has been considered, for the purpose of obtaining better plant response to changes in load demand. The plant control system has been designed with account taken of the results of the above preliminary studies, and the plant responses have been calculated for changes of plant power setting. (auth)

12192 APPLICATION OF A DUAL-PROCESSOR CONCEPT TO THE REACTOR POWER CONTROL AT STADE NUCLEAR POWER STATION. Corpus, W.; Graf, G. (Kraftwerk Union A. G., Erlangen, Ger.). Siemens-Z.; 47: No. 7, 530-535(1973). (In German).

The increasing availability of processing computer equipment is being tried out at the nuclear power plant, Stade, with a dual-processor system has two independent central processors coupled together. The periphery units are partly firmly assigned and partly switchable. Under normal operating conditions both computers share the tasks given according to a fixed prescribed scheme. A change of the allotment of the tasks only occurs in the case of an accident, i.e. if working processor as process coupled system breaks down. In this case the second processor can take over the most important control tasks of the first one. (GE)

12193 APPLICATION OF THE EXPERIMENTAL DESIGN METHOD TO PROBLEMS IN POWER REACTOR OPERATION. Huang, H. C. Pittsburgh; Carnegie-Mellon Univ. (1973). 147p. University Microfilms Order No. 73-21,077.

Thesis (Ph. D.).

The use of on-line digital systems for power reactor control is described. At present, certain non-measurable operating parameters such as those which describe the power distribution are being calculated on certain light water reactors by using the on-line digital system. However, both the concept and method employed in implementing the calculations still retain the same favor which has been the basic technique in conventional digital applications, i.e., iterative techniques. Therefore, much more of the information provided by the instrumentation and the on-line digital system await to be exploited. In a parallel developing area, increasing effort has been in progress in developing on-line digital control schemes. Here again, the theoretical concepts developed have to rely upon some iterative digital programs to obtain the non-measurable system state variables. Therefore, their real-time control capability cannot be concluded. The method developed and described offers a new approach to the solution of the problem. It has the advantage of high speed when performing the on-line digital calculations, and it utilizes the digital capability to construct the calculational model beforehand. As a result, it can bring about much improved utilization of the instrumentation and on-line digital system. Computer time for the model construction is assessed and is shown to be relatively small. Equations for estimating the on-line time as required by the model are given. Such time falls in the multimicrosecond range depending upon the digital system and is always an insignificant fraction of that required by iterative digital programs. (Diss. Abstr. Int., B)

12194 REAL-TIME DDC REALLY WORKS. Can. Chem. Process.; 57: No. 4, 42-44(Apr 1973).

The use of two computers to control Pickering nuclear power station is explained, with brief mention of a similar system at Gentilly. The second computer is used to provide back-up for the first. The use of a second computer has been justified by a reliability study on one of Pickering's 500 MW units: over a 139 day period, the downtime was 4 minutes, whereas had only one computer been used, it would have been 5 days. Experience for the system of direct digital control was gained by the use of one CDC 636 computer at Douglas Point, and led to improvements such as these: line printers are used in preference to typewriters; a fixed-head drum memory with a capacity for 131,072 words is used; the number of alarm windows in the control room is kept to the minimum. The back-up computer is used in both parallel-control and standby control modes. In the former, the two computers control different field control devices (e.g., valves), whereas in the latter, they both have access to the same field device, but the control signals from the second computer are not used unless the first computer fails. (CA)

12195 DYNAMIC CHARACTERISTICS OF PWR TYPE NUCLEAR POWER PLANT CONNECTED TO POWER SYSTEM. Koyama, S.; Wakamatsu, S.; Shirai, K. (Electrotechnical Lab., Tokyo). Denshi Gijutsu Sogo Kenkyusho Iho; 37: No. 4, 444-461(Apr 1973).

A method of the digital analysis for studying power systems including PWR type nuclear power plants is presented. The method is available for studying on the overall optimal control and operation of power systems as well as those of nuclear plants. Typical results analyzed by the method are presented, showing that PWR type nuclear plants are capable to be joined in the load-frequency control of a power system like usual thermal plants. It is suggested that further study is required to realize the actual operation of a nuclear power plant as a power-system-slaved plant. (auth)

12196 NUCLEAR POWER PLANT PROCESS COMPUTER SYSTEM FOR SHIMANE P.S. NO. 1 OF THE CHUGOKU ELECTRIC POWER CO. Masaoka, N. (Chugoku Electric Power Co. Inc., Hiroshima); Nakata, A.; Iida, H.; Inaba, G. Hitachi Hyoron; 55: No. 8, 833-838(Sep 1973). (In Japanese).

A process computer system for Shimane Nuclear Power Station No. 1 has been developed. As a system using domestic-made computer, this is the first of its kind in this country. Also, provided with a color CRT (Cathode Ray Tube), this system has made it possible to visually supervise the reactor core. (auth)

12197 UTILIZATION OF THE BURNABLE NEUTRON POISON CADMIUM IN THE FORM OF A NEUTRON ABSORBER. Hattenbach, K.; Baur, E.; Melkonian, G. A. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). German Patent 1,764,264. 19 Apr 1973. 1p. (In German).

The neutron absorber described contains a spinel type of mixed oxide having the formula $Me(I)\ Me(II)_2O_4$, where Me(I) stands for zirconium and Me(II) for cadmium, or Me(I) for cadmium and Me(II) for aluminum. The absorber also consists of a mixed oxide made from a mixture of mixed oxides with a ceramic substance of low neutron absorption cross section or of a cermet from the mixed oxide with a low neutron absorption cross section metal. (GE)

12198 IMPROVED CYLINDRICAL LINEAR HYDROSTATIC ACTUATORS. Warder, G. E. E. British Patent 1,325,545. 1 Aug 1973. Filed date 22 Aug 1969. 6p.

Reference is made to pressurized fluid actuators adapted for sliding objects along bores or slideways for such purposes as the positioning of control rods in nuclear reactors. The actuator described is of robust construction and high efficiency, and in operation is subject to little friction and wear, is capable of operation from low creep speeds to rapid traverse, and in which pulsations are substantially avoided. It is suitable for vertical as well as horizontal applications. Full constructional details are given. (UK)

12199 NUCLEAR REACTORS AND CONTROL MEANS. Challender, R. C. (to United Kingdom Atomic Energy Authority).

British Patent 1,325,503. 1 Aug 1973. Filed date 28 Jun 1971. 3p.

Reference is made to control means for reactors having vertical channels for control rods. In an emergency the core could become distorted so that the rods cannot be fully injected into the channels to effect immediate shutdown. In some cases additional channels are provided, with means for injecting boron steel balls on receipt of an emergency signal; disadvantages of this arrangement, however, are stated. In the system described the control means comprises an elongated canister having a lower portion slidable with clearance in the channel and an upper portion having a cross-section greater than the cross-section of the channel. The canister contains balls of material of high neutron absorption cross-section, retained within both portions of the canister against gravity by a lower closure member. The canister is suspended by the closure member with its lower end closed and in alignment with the channel, so that its lower portion is variably positionable within the channel by means sensitive to reactor characteristics for the purpose of reactivity control. The closure member is arranged so that in the event of the lower portion of the canister becoming jammed during downward movement the closure member continues to move downward, releasing the balls to effect complete reactor shutdown. The arrangement provides that the normal control means can also be utilized for emergency shutdown, without the provision of additional channels, thereby saving reactor space and reducing instrumentation. Since the balls are normally retained within the canister they are readily recoverable after a spurious shutdown. (UK)

Nuclear Power Plant Economics

Refer also to abstracts 11762, 11883, 11986, 12035, 12375, and 12377.

12200 (INIS-mf-785) ROLE OF ROAD IMPROVEMENTS IN THE ATOMIC POWER PROGRAMME. Vengurlekar, V. R.; Ramachandran, V.; Tilak, M. M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

The road improvement problems in the context of the Indian atomic power program, based on the experience gained in the consignments that have moved and are planned for movement for Rajasthan Atomic Power Project and Madras Atomic Power Project with projections for the future are discussed. A detailed survey of the capacity of the existing roads, evaluation of the strength of existing bridges and the determination of the extent of improvements necessary to bring them to the required standards for the safe passage of heavy and over-dimensioned consignments reveal that the existing standards prescribed by the Indian Ministry of Shipping and Transport for improvements of the roads forming the national grid fall short of the requirements even for the currently envisaged weights of consignments and the situation is more acute for the larger size single units of 500 MW(e) and above. For the present, individual consignment weight extends to 180 tons with projections of upto 300 tons in the not too distant future when the larger single size units of 500 MW(e) and above will be taken up for installation. (INIS)

12201 (INIS-mf-848) ROLE OF INDUSTRIES IN FABRICATION OF REACTOR COMPONENTS. Arumugham, P. N. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

A brief survey of the participation of industries in other countries in their respective civilian nuclear power programs is presented and the current involvement of the Indian industry in the Indian nuclear power program is reviewed. The contribution from Indian industry has progressively reduced the extent of foreign exchange required for the construction of Indian nuclear power stations. With this development, a stage has come where there is need for formulation of suitable policies for industrial participation, without which a viable and meaningful participation cannot be an effective feature. The deficiencies in the current situation are highlighted, with emphasis on the Indian nuclear program and its optimum and rational management capability. (auth)

12202 STRUCTURAL REORGANIZATION OF THE ITALIAN ADVANCED REACTOR INDUSTRY. Fogagnolo, G. Nucl. Eng. Int.; 18: No. 209, 787-790(Oct 1973).

The formation of a new company for the development of advanced reactor types, Nucleare Italiana Reattori Avanzati, i.e., NIRA, is described. Its functions, which are discussed, include the construction of the sodium cooled fast flux test facility PEC, the construction of the CIRENE reactor, and participation in the European scheme for the construction of two power stations of more than 1000 MW(e) equipped with sodium-cooled fast reactors. (UK)

12203 EIGHT REPORT FROM THE COMMITTEE OF PUBLIC ACCOUNTS, TOGETHER WITH THE PROCEEDINGS OF THE COMMITTEE, PART OF THE MINUTES OF EVIDENCE, APPENDICES, AND INDEX, SESSION 1972–1973. London; Her Majesty's Stationery Office (1973). 216p. £2.15.

This report is concerned mainly with the financial aspects of the development of nuclear reactor systems in the UK, and the transfer of the UK Trading Fund activities to British Nuclear Fuels Ltd. and the Radiochemical Centre Ltd., Amersham. Reactor types considered are Magnox, AGR, HTR, SGHWR, and FBR. Minutes of evidence and examination of witnesses are included. (UK)

12204 INDUSTRY'S POSITION CONCERNING NUCLEAR PROCESS HEAT. Memorandum Calls for a Coordinated Development Programme. Sandscheper, G. VDI (Ver. Deut. Ing.) Nachr.; 27: No. 28, 2(1973). (In German).

A review is given of the basic considerations from the Memorandum for the production and application of nuclear process heat presented on 3rd July 1973 by the HRB high temperature reactor construction GmbH in Cologne. It is shown that industry is strongly engaged in the use of HTR potential. The pressing development tasks to be solved are the following: optimum control of the chemical processes, material development, and improvement of fuel element properties (decrease of fissionable fuel escape). (GE)

12205 DEVELOPMENT OF THE CONVENTIONAL AND THE NUCLEAR POWER STATION CAPACITY OF THE ELECTRICITE DE FRANCE. Krivine, G.; Lagarde, J. F. (Electricite de France, Paris). Elektrizitaetswirtschaft; 72: No. 15, 539-545 (1973). (In German).

From annual meeting of the Vereiningund Deutscher Elektrizitaetswerke e.V.; Duesseldorf, Ger. (22 May 1973).

Investigations were conducted on the increase in electricity consumption in France, the method used for selecting the different power station types, and the future development of conventional and nuclear power station capacity. Finally some data concerning the problems which arise in connection with the protection of the environment and with the location of the power stations are given. (GE)

12206 NUCLEAR ENERGY IN EASTERN EUROPE. Lavrencic, D. (Comitato Nazionale per l'Energia Nucleare, Rome). Atomwirt., Atomtech.; 18: No. 10, 473-486(1973). (In German).

To further the development of nuclear energy in its member countries, the COMECON founded in 1960 the permanent COMECON Commission for Peaceful Uses of Nuclear Energy with headquarters in Moscow. In this commission Bulgaria, Czechoslovakia, Germany (Democratic Republic), Hungary, Poland, Romania, and the USSR participate. Within the USSR there are at present 16 nuclear reactors in operation. In the other COMECON countries, nuclear development has so far been slow. Eastern Germany and Czechoslovakia are the only countries with one nuclear power station each in operation. A new program published in 1971, however, has the objective of installing about 10,000 MWe nuclear capacity until 1980 within the COMECON countries outside of USSR. Nuclear power stations to be constructed before 1985 will be mainly of the PWR and RBMK type developed in the USSR. In the USSR, reactors of these types with a total generating capacity of 30,000 MWe are to be installed by 1985. After this date, fast breeders of the type developed in the USSR will be constructed. A complete survey is given of the energy situation, the short- and long-term planning, and the role of nuclear energy within the COMECON countries and describes in detail the development and the construction of the Soviet reactor types as well as the nuclear power programs of all COMECON countries. (auth)

12207 NUCLEAR ENERGY IN JAPAN: SPECIAL PROBLEMS. A Review. Arch. Energiewirt.; 27: No. 17, 831-836(1973). (In German).

In a short review, the problems involved in Japan's present energy policy are outlined. Programs for the erection of nuclear power plants are intended to guarantee meeting the increasing demand of energy. Special problems arising in the construction of nuclear power plants in Japan are reported. (GE)

12208 NUCLEAR POWER FOR ITALY. Angelini, A. M. (Ente Nazionale per l'Energia Elettrica, Rome). Nucl. Eng. Int.; 18: No. 209, 780-781(Oct 1973).

Electricity requirements in Italy are summarized. The role of the current nuclear stations is outlined. Short term plans, which will provide for an additional 1000 MW(e) by 1974 are discussed,

also long-term forecasts. The interest of ENEL in more advanced technologies includes plutonium recycle in thermal reactors, the Cirene prototype reactor, and initiative in the construction of the two fast reactor demonstration plants, Phenix and SNR. (auth)

12209 INTRODUCTION TO THE NUCLEAR INDUSTRY IN ITALY. Riccio, G. Nucl. Eng. Int.; 18: No. 209, 783(Oct 1973).

An extremely brief outline is given of the establishment of nuclear power plants in Italy and of the future plans of the Italian Electricity Board, ENEL, for participation in overseas markets both in reactor component manufacture and in the fuel cycle. (UK)

12210 ITALIAN NUCLEAR POWER INDUSTRY. Bullio, P. Nucl. Eng. Int.; 18: No. 209, 784-787(Oct 1973).

The Italian nuclear power industry is based on a mixture of State controlled groups of companies working either in cooperation, or in competition with private companies. The activities of the main groups in the field of reactors, components, and fuel cycles are described. A folding chart is also included showing the structure of the nuclear industry including national bodies, research centers, research groups, industrial concerns and services, and indicating the areas of international collaboration and foreign associations. (UK)

12211 IRI/FINMECCANIC'S UNIFIED REACTOR MANUFACTURE CAPABILITY. Della Volta, F. Nucl. Eng. Int.; 18: No. 209, 791-793(Oct 1973).

A brief historical background is given of the evolution of the Fimmeccanica group of companies through which the industrial corporation, IRI, operates in the nuclear field. The main products and responsibilities of the various companies in the group in the manufacturing field for boiling light water and heavy water reactors are summarized. (UK)

12212 HEAT SUPPLY FROM NUCLEAR POWER PLANTS FOR INDUSTRIAL AND MUNICIPAL USES. Reetz, B. (Technische Univ., Dresden). Kernenergie; 16: No. 6, 177-183(Jun 1973). (In German).

The situation in primary energy resources and balance of process energy as well as aspects of environmental protection are insistent on necessity and usefulness of nuclear heat supply. The results of economic studies are discussed, and published designs, projects, and plants are described with regard to the possibilities of applying reactors to heat supply for high-temperature processes, heating power stations, heating installations, desalination of sea water, and in agro-industrial complexes. The equipment of heat supplying installations with reactors of advanced unit power unquestionably is advantageous. A development of small and medium power reactors oriented toward optimum layout and rational manufacture seems to favor single- and multi-purpose installations of small power. (auth)

12213 NUCLEAR POWER FROM WATER-COOLED REACTORS: IS THE CHOICE CORRECT? McHugh, B. (Chalmer Tekniska Hodgskola, Goteborg). Mod. Kemi; No. 3, 26-28(Mar 1973). (In Swedish).

For central station duty, a reactor plant must be capable of timely commissioning and acceptable load factors. The water-cooled reactor possesses a number of disadvantages in this respect compared with the gas-cooled reactor. From a safety viewpoint, the two-phase behavior of water prevents an easy determination of the consequences of a major accident where a highly active coolant can be dispersed into the plant surroundings. From the operational viewpoint, experience seems to show that the long-term behavior of water-cooled plant is subject to a degradation in terms of the possible load factors achieved. Thus it should be of vital interest to prepare the way now for the introduction of gas-cooled plant into the national grid—a move that will certainly be necessary in the long run. (auth)

12214 NUCLEAR POWER IN THE IRON-INDUSTRY. Ernst, K. R. Tech. Zukunft; No. 6, 93-96(1973). (In German).

Following a few basic comments on the production of heat from nuclear reactors, in particular high-temperature reactors, various smelting processes as uses are described. The direct reduction of steel with gas-forming and solid reducing agents are of particular interest. The costs and profitableness of nuclear energy are compared with those of other energy carriers. The generation of beams of sponge iron is considered to be economically the most promising use of nuclear energy. (GE)

12215 OPTIMIZATION OF THE STRUCTURE OF GENERATING FACILITIES IN THE PLANNING OF COMBINED POWER SYSTEMS. Eyurii, Kh. Tr. Mosk. Energ. Inst.; No. 109, 159-169(1972). (In Russian).

A mathematical model is suggested for determination of the optimal structure of the generating facilities of a power system with fixed external connections for a five-year period. Simplified indicators are fixed for load graphs, as well as the basic technical and economic characteristics of existing power systems, power systems under construction and new power systems. The criterion for optimization is the minimum adjusted calculated expenditures for the power system and fuel for the calculation period, while observing the conditions of coverage of the balance of capacity and power production. The optimal composition of power system equipment and the number of hours of utilization of the capacity of power plants of each type are determined for each design year. The following types of power plants are used in the optimization calculations: gas turbine units, pumped-storage power plants, nuclear power plants and modular condensation power plants. (JPRS)

12216 NUCLEAR POWER STATIONS WITHIN THE FRAMEWORK OF THE ENERGY POLICY FOR THE NORTH GERMAN COASTAL AREA. Gueltzow, H. A. (Hamburgische Electricitaets-Werks AG, Hamburg). At. Strom; 19: No. 7-8, 69-73(1973). (In German).

The North German coastal area which until recently was regarded as a development area, has in the last few years become a topic of discussion because of spectacular industrial estates. The North German electric utility firms are making their contribution to the further economic development of the coastal region by providing electric power cheaply and reliably. The point of view of a utility with regard to the impending decisions on further investment is explained. (GE)

12217 POWER PLANTS 1973. Granitzer, H. Energie; 25: No. 9, 258-264(1973). (In German).

From annual meeting 1973 of the VGB Technischer Vereinigung der Grosskraftwerksbetreiber; Vienna, Austria (26 Jun 1973).

Following a brief report on the introduction to the meeting (celebrity lecture, honors), a summary is given of the lectures at the congress which deal with the most important problems of conventional and nuclear energy production in power plants. (GE)

Reactor Fuel Cycle Economics

Refer also to abstracts 12208–12210.

12218 NUCLEAR POWER FOR ALL. Facilitating Its Introduction Into Developing Countries. Energy Int.; 9: No. 9, 16-17 (Sep 1972).

A discussion is presented of the economic importance of introducing nuclear power plants into developing countries. At present nuclear power plants are in operation in only two developing countries, India and Pakistan. The costs of uranium, enrichment, fabrication, and reprocessing are discussed in contrast to the costs of oil-fired stations. The necessity for developing countries to improve organization of power industry and to adopt safety standards is pointed out. A survey to determine the requirements for nuclear power plants in developing countries during the next ten years was initiated by the IAEA, and 12 developing countries have responded to the invitation to take part in the survey. (HLW)

12219 NUCLEAR FUEL CYCLE SITUATION IN ITALY. Campanini, M. (AGIP Nucleare, Milan). Nucl. Eng. Int.; 18: No. 209, vp(Oct 1973).

One result of the organization by government agencies of the nuclear industry in Italy is that of the ENI company, AGIP Nucleare, assuming a major role in all phases of the nuclear fuel cycle. A short outline is given of the different stages of the cycle, i.e., hexafluoride conversion, uranium enrichment, fuel manufacture and reprocessing, in order to show the changes taking place. (UK)

Reactor Licensing and Regulation

12220 (DOCKET-50010-207) DRESDEN NUCLEAR POWER STATION, UNIT 1. Unplanned Radioactive Release From Rad-Waste. (Commonwealth Edison Co., Chicago, Ill. (USA)). 29 Nov 1973. 3p. Dep. NTIS $3.00.

12221 (DOCKET-50133-142) HUMBOLDT BAY POWER PLANT, UNIT 3. Malfunction of the Propane Engine Driven Generator. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 5 Dec 1973. 3p. Dep. NTIS $3.00.

12222 (DOCKET-50155-178) BIG ROCK POINT REACTOR. Abnormal Occurrence AO-11-73: the 6" Off-gas Bypass Valve on the Condenser Off-gas System Was Found in the Open Position; Abnormal Occurrence AO-12-73: Malfunction of Four High Condenser Pressure Scram Bypass Pressure Switches; Abnormal Occurrence AO-13-73: the Compensating Power Supply for the Chan-

nel 4 Log N/Period Monitor Was Found to Be Reversed in Polarity. (Yankee Atomic Electric Co., Westboro, Mass. (USA)). 13 Nov 1973. 2p. Dep. NTIS $3.00.

12223 (DOCKET-50155-181) BIG ROCK POINT NUCLEAR PLANT. During Draining of Fuel Pool, a Spent Fuel Rod Was Found on the Pool Floor. (Consumers Power Co., Jackson, Mich. (USA)). 20 Nov 1973. 2p. Dep. NTIS $3.00.

12224 (DOCKET-50155-182) BIG ROCK POINT NUCLEAR PLANT. Abnormal Occurrence Report AO-16-73: A Sample of Water from the Shell Side of the Emergency Condenser Was Found to Contain an Abnormal Amount of Short-Lived Activity in the Form of Entrained Fission Gas. (Consumers Power Co., Jackson, Mich. (USA)). 27 Nov 1973. 1p. Dep. NTIS $3.00.

12225 (DOCKET-50155-183) BIG ROCK POINT NUCLEAR PLANT. Unusual Event: An Observed Reduction in the Ability of the Reserve Nitrogen Supply System to Operate the Containment Sphere Ventilation Valves. (Consumers Power Co., Jackson, Mich. (USA)). 27 Nov 1973. 2p. Dep. NTIS $3.00.

12226 (DOCKET-50206-253) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Incident Report: Excessive Smoke Was Observed Coming From the Exhaust of No. 2 Diesel. (Southern California Edison Co., Rosemead, Calif. (USA)). 20 Nov 1973. 2p. Dep. NTIS $3.00.

12227 (DOCKET-50213-247) HADDAM NECK PLANT. Abnormal Occurrence Report No. 73-8: Failure of Steam Generator Seismic Support Hold-down Bolts. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 19 Sep 1973. 2p. Dep. NTIS $3.00.

12228 (DOCKET-50219-342) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Closed Cooling Water System Leakage. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 8 Nov 1973. 3p. Dep. NTIS $3.00.

12229 (DOCKET-50219-349) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. 73-26: Failure to Set the Average Power Range Monitor Scram and Rod Block Set Points to the Conservative Specified Values. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 11 Oct 1973. 3p. Dep. NTIS $3.00.

12230 (DOCKET-50219-350) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Preliminary Abnormal Occurrence Report No. AO-73-23: Failure of Differential Pressure Switch DPS 66A to Trip and Thereby Actuate the Reactor Building to Torus Vacuum Breaker Block Valves, V-26-16 and 18. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 25 Sep 1973. 3p. Dep. NTIS $3.00.

12231 (DOCKET-50220-193) NINE MILE POINT NUCLEAR STATION, UNIT 1. During Routine Calibration of LPRM and Subsequent Core Power Distribution Calculation Fuel Bundle Segments were Found to be Operating Slightly in Excess of the Allowable Average Planar LHGR. (Niagara Mohawk Power Corp., Syracuse, N.Y. (USA)). 1973. 1p. Dep. NTIS $3.00.

12232 (DOCKET-50220-198) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-11-20: Failure of Eleven Control Rod Drives to Insert to Notch Position Following a Reactor Scram. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 28 Nov 1973. 2p. Dep. NTIS $3.00.

12233 (DOCKET-50237-426) DRESDEN NUCLEAR POWER STATION, UNIT 2. Additional Data on Isolation of Isolation Condenser System. (Commonwealth Edison Co., Chicago, Ill. (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

The incident on October 19, 1973 involving the isolation of the isolation condenser system was found to have been caused by a difference in the routing of the sensing lines for the condensate return line pressure switches. The switches were recalibrated taking into account the sensing line routing. (JWR)

12234 (DOCKET-50237-429) DRESDEN NUCLEAR POWER STATION, UNIT 2. Abnormal Occurrence Report: the HPCI System Was Declared to be Inoperable Due to a 125 Volt and 250 Volt Ground. (Commonwealth Edison Co., Chicago, Ill. (USA)). 30 Nov 1973. 2p. Dep. NTIS $3.00.

12235 (DOCKET-50244-217) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-73-6 and 73-7: Failure of Sensing Line on "B" Auxiliary Feedwater Pump. (Rochester Gas and Electric Corp., N. Y. (USA)). 1 Aug 1973. 3p. Dep. NTIS $3.00.

12236 (DOCKET-50244-218) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence Report No. AO-73-9: Excessive Reactor Coolant Cooldown Rate; Abnormal Occurrence Report No. AO-73-10: Malfunction of Safety Injection Pump Suction Transfer From Boric Acid Storage Tanks to Refueling Water Storage Tank. (Rochester Gas and Electric Corp., N. Y. (USA)). 23 Oct 1973. 4p. Dep. NTIS $3.00.

12237 (DOCKET-50244-221) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. USAEC Final Environmental Statement. (Rochester Gas and Electric Corp., N. Y. (USA)). Dec 1973. 299p. Dep. NTIS $17.00.

The environmental effects of construction and operation of the Ginna Nuclear Power Plant, Unit 1 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

12238 (DOCKET-50247-154) INDIAN POINT STATION, UNIT 2. Incident Report: A Turbine Trip Occurred Due to High Feedwater in Steam Generator No. 23 Resulting in Shutdown of the Operating Main Boiler Feed Pump Which Caused the Level of All Four Steam Generators to Decrease. (Consolidated Edison Co. of New York, Inc., New York (USA)). 14 Nov 1973. 3p. Dep. NTIS $3.00.

12239 (DOCKET-50247-157) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-17: During Maintenance of the Closure Mechanism of the 80' Elevation Outer Door of the Vapor Container, the Inner Door Was Partially Opened for a Short Period. (Consolidated Edison Co. of New York, Inc., New York (USA)). 17 Sep 1973. 1p. Dep. NTIS $3.00.

12240 (DOCKET-50247-159) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-13: Loss of Generator Field Relay Action Resulted in a Trip. (Consolidated Edison Co. of New York, Inc., New York (USA)). 12 Oct 1973. 2p. Dep. NTIS $3.00.

12241 (DOCKET-50247-162) INDIAN POINT STATION, UNIT 2. Abnormal Occurrence Report No. AO-3-2-15: Leaks Were Observed at the $^{3}/_{4}$ inch Pipe to Socket Weld Branch Connections for Vents S-47 and S-51. (Consolidated Edison of New York, Inc., New York (USA)). 12 Nov 1973. 3p. Dep. NTIS $3.00.

12242 (DOCKET-50247-163) INDIAN POINT STATION, UNIT 2. Incident Report: A Turbine Trip Occurred due to High Feedwater in the Steam Generator No. 23 Resulting in a Shutdown of the Operating Main Boiler Feed Pump. (Consolidated Edison Co. of New York, Inc., New York (USA)). 14 Nov 1973. 3p. Dep. NTIS $3.00.

12243 (DOCKET-50249-315) DRESDEN NUCLEAR POWER STATION, UNIT 3. Failure of Diesel Generator Air Starting System. (Commonwealth Edison Co., Chicago, Ill. (USA)). 6 Nov 1973. 2p. Dep. NTIS $3.00.

12244 (DOCKET-50249-319) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence: 2/3 Core Height Level Sensors Found to Be Out of Calibration. (Commonwealth Edison Co., Chicago, Ill. (USA)). 19 Nov 1973. 2p. Dep. NTIS $3.00.

12245 (DOCKET-50249-321) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence: Malfunction of Core Spray System M.O. Valve 1402-38A. (Commonwealth Edison Co., Chicago, Ill. (USA)). 15 Nov 1973. 2p. Dep. NTIS $3.00.

12246 (DOCKET-50250-163) TURKEY POINT PLANT, UNIT 3. Abnormal Occurrence Report No. AO-3-72-8 (Supplement): Evaluation of Tests and Inspections Following the No. 3 Battery Charger Fire. (Florida Power and Light Co. (USA)). 26 Nov 1973. 4p. Dep. NTIS $3.00.

12247 (DOCKET-50251-170) TURKEY POINT PLANT, UNIT 4. Abnormal Occurrence Report No. AO-4-73-3, Supplement: Results of Inspections to Determine the Cause of No. 4A Residual Heat Removal Pump Leakage. (Florida Power and Light Co. (USA)). 24 Nov 1973. 3p. Dep. NTIS $3.00.

12248 (DOCKET-50254-302) QUAD-CITIES STATION, UNIT 1. Abnormal Occurrence: the Reactor Coolant Leakage into the Primary Containment Exceeded 5 gpm. (Commonwealth Edison Co., Cordova, Ill. (USA)). 29 Nov 1973. 3p. Dep. NTIS $3.00.

12249 (DOCKET-50259-225) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Environmental Statement, Volume 1. (Tennessee Valley Authority, Chattanooga (USA)). 1 Sep 1972. 432p. (DOCKET-50260-126; DOCKET-50296-116). Dep. NTIS $23.75.

Information on the environmental impact of the Browns Ferry Nuclear Power Station, Units 1, 2, and 3, is presented under the following headings: environmental effects which cannot be avoided; alternatives; short-term uses versus long-term productivity; irreversible and irretrievable commitments of resources; and benefit-cost weighing and balancing. Comments and responses to comments on the draft environmental statement are also included. (JWR)

12250 (DOCKET-50259-232) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7336W: HPCI Inverter Power Supply Fuse Failure. (Tennessee Valley Authority, Chattanooga (USA)). 21 Nov 1973. 3p. Dep. NTIS $3.00.

12251 (DOCKET-50259-234) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7337-W: Malfunction of Core Spray Pump Discharge Pressure Switch. (Tennessee Valley Authority, Chattanooga (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

12252 (DOCKET-50259-244) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7353W-7356W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

12253 (DOCKET-50259-245) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7340W: Malfunction of HPCI Steamflow Excessive Pressure Switches. (Tennessee Valley Authority, Chattanooga (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

12254 (DOCKET-50259-246) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7338W: RCIC and HPCI Failures. (Tennessee Valley Authority, Chattanooga (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

12255 (DOCKET-50259-247) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7339W: Malfunction of Reactor Protection System Condenser Low-Vacuum Switch. (Tennessee Valley Authority, Chattanooga (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

12256 (DOCKET-50259-248) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7341W: Malfunction of Reactor Protection System Water-Level Switch. (Tennessee Valley Authority, Chattanooga (USA)). 26 Nov 1973. 3p. Dep. NTIS $3.00.

12257 (DOCKET-50259-250) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7343W: Significant Vibration in Torus and Torus-Ring Header Upon Opening Relief Valves During Startup Testing. (Tennessee Valley Authority, Chattanooga (USA)). 28 Nov 1973. 2p. Dep. NTIS $3.00.

12258 (DOCKET-50259-255) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7357W-7363W: Fish Impingement Estimates. (Tennessee Valley Authority, Chattanooga (USA)). 30 Nov 1973. 2p. Dep. NTIS $3.00.

12259 (DOCKET-50261-282) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence Report No. 73-70: Primary to Secondary Leak in Steam Generator C. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 23 Nov 1973. 2p. Dep. NTIS $3.00.

12260 (DOCKET-50261-283) H. B. ROBINSON PLANT, UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels, October 1973. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 19 Nov 1973. 2p. Dep. NTIS $3.00.

12261 (DOCKET-50263-273) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Reactor Building to Suppression Chamber Vacuum Breaker Check Valve, DWV 8-1 Would not Operate Freely. (Northern States Power Co., Minneapolis, Minn. (USA)). 9 Nov 1973. 1p. Dep. NTIS $3.00.

12262 DOCKET-50263-274) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Standby Liquid Control Tank Level Indicators Were Improperly Calibrated. (Northern States Power Co., Minneapolis, Minn. (USA)). 14 Nov 1973. 1p. Dep. NTIS $3.00.

12263 (DOCKET-50263-275) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Malfunction of MSIV-2-80A. (Northern States Power Co., Minneapolis, Minn. (USA)). 3 Aug 1973. 1p. Dep. NTIS $3.00.

12264 (DOCKET-50263-276) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Malfunction of Suppression Chamber to Reactor Building Primary Containment Check Valve. (Northern States Power Co., Minneapolis, Minn. (USA)). 19 Nov 1973. 2p. Dep. NTIS $3.00.

12265 (DOCKET-50263-281) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Second Reload Submittal. (Northern States Power Co., Minneapolis, Minn. (USA)). 19 Nov 1973. 131p. Dep. NTIS $8.75.

Reload-2 fuel will employ an 8 × 8 fuel assembly configuration instead of the previously used 7 × 7. The pellet diameter, pellet length, cladding diameter, and rod pitch are changed from 7 × 7 design; however, the assembly exterior dimensions remain unchanged. The basic materials and fuel fabrication process used are the same as those used on the 7 × 7 design. The design reference core configuration for this license submittal consists of 116 Reload-2 new fuel bundles with an average enrichment of 2.62 wt% U-235, 20 Reload-1 fuel bundles with an average exposure about 5550 MWd/t and 348 Initial fuel bundles with an average exposure about 10,300 MWd/t. All temporary control curtains are removed from the core. The Reload-2 fuel bundle uses gadolinium for reactivity control augmentation. The relative location of the Reload-2 fuel bundles is shown. The design reference core was developed from an extrapolation from expected cycle 2 operation to the end of cycle and it contains extensive shuffling of irradiated fuel assmeblies. At the time of the outage the final core loading will be analyzed and compared to the design reference case to insure that the core meets license requirements. Shutdown calculations were made on the full use of all Reload-2 bundles. Ample shutdown margin for the most reactive condition in the cycle was calculated for the design reference core. Results indicate that the reactor will be able to operate safely at 1670 MW(t) after the outage and satisfy all license requirements. (auth)

12266 (DOCKET-50270-138) OCONEE NUCLEAR STATION, UNIT 2. Abnormal Occurrence Report No. AO-73-3: Reactor Coolant System Heatup Limitations. (Duke Power Co., Charlotte, N. C. (USA)). 23 Nov 1973. 7p. Dep. NTIS $3.00.

12267 (DOCKET-50271-257) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-27: An Apparent Detonation in the Off-gas System Caused Sufficient Back Pressure to Fracture the Air Ejector Rupture Disc. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 10 Sep 1973. 2p. Dep. NTIS $3.00.

12268 (DOCKET-50271-260) VERMONT YANKEE NUCLEAR POWER STATION. Data on Channel Box Wear. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 16 Nov 1973 10p. Dep. NTIS $3.00.

12269 (DOCKET-50271-262) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-32: Failure of Both Gaskets on the Gland Seal Exhaust Condenser of the HPCI System. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 28 Nov 1973. 2p. Dep. NTIS $3.00.

12270 (DOCKET-50275-69) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Report on Inspection of Stainless Steel Piping Welds. (Pacific Gas and Electric Co., San Francisco, Calif. (USA)). 1 Dec 1973. 4p. Dep. NTIS $3.00.

12271 (DOCKET-50277-162) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: Two Pressure Switches Monitoring Primary System Pressure and a Reactor Vessel Level Switch Were Found to be out of Calibration. (Philadelphia Electric Co., Pa. (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

12272 (DOCKET-50277-165) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence Report: Malfunction of Reactor Level Switch LIS-2-2-3-101B. (Philadelphia Electric Co., Pa. (USA). 1 Dec 1973. 2p. Dep. NTIS $3.00.

12273 (DOCKET-50280-195) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-14: Failure of Overhead Gas Compressor High Pressure Alarm. (Virginia Electric and Power Co., Richmond (USA)). 23 Nov 1973. 9p. Dep. NTIS $3.00.

12274 (DOCKET-50281-163) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-10: Failure of Safety Injection/Charging Pump 2-CH-P-1B to Start on a Safety Injection Signal. (Virginia Electric and Power Co., Richmond (USA)). 23 Nov 1973. 8p. Dep. NTIS $3.00.

12275 (DOCKET-50281-164) SURRY POWER STATION, UNIT 2. Abnormal Occurrence Report No. AO-S2-73-11: Failure of MOV-FW-251B to Fully Open upon Safety Injection. (Virginia Electric and Power Co., Richmond (USA)). 23 Nov 1973. 7p. Dep. NTIS $3.00.

12276 (DOCKET-50282-181) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report of Valve Operators With Unsatisfactory Insulation and Seals Within Containment. (Northern States Power Co., Minneapolis, Minn. (USA)). 23 Nov 1973. 2p. (DOCKET-50306-143). Dep. NTIS $3.00.

12277 (DOCKET-50282-183) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Inoperability of Diesel Generator Following Routine Insulation Resistance Checks. (Northern States Power Co., Minneapolis, Minn. (USA)). 14 Nov 1973. 2p. Dep. NTIS $3.00.

12278 (DOCKET-50282-185) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Disc Replacement in Main Steam Isolation and Check Valves. (Northern States Power Co., Minneapolis, Minn. (USA)). 27 Nov 1973. 3p. (DOCKET-50306-145). Dep. NTIS $3.00.

12279 (DOCKET-50282-186) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Corrosion Problems in Refueling Water Storage Tanks. (Northern States Power Co., Minneapolis, Minn. (USA)). 27 Nov 1973. 3p. (DOCKET-50306-146). Dep. NTIS $3.00.

12280 (DOCKET-50285-148) FORT CALHOUN STATION, UNIT 1. Unusual Event Report No. 73-10: Vibration of Main Steam Lines and Discharge Piping From the Steam Dump and Bypass Valves. (Omaha Public Power District, Nebr. (USA)). 28 Nov 1973. 6p. Dep. NTIS $3.00.

12281 (DOCKET-50289-143) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Reactor Building Ring Girder Surveillance Report. (Metropolitan Edison Co., Reading, Pa. (USA)). 12 Nov 1973. 42p. Dep. NTIS $4.25.

12282 (DOCKET-50293-210) PILGRIM NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-73-37: Malfunction of Barksdale Model B2T-M12SS Pressure Switches. (Boston Edison Co., Mass. (USA)). 3 Dec 1973. 1p. Dep. NTIS $3.00.

12283 (DOCKET-50295-213) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: The Pressurizer Hi and Lo Setpoints of 1LC461A Were Found to be Out of Tolerance. (Commonwealth Edison Co., Zion, Ill. (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

12284 (DOCKET-50295-218) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: Instrument Line Failure, Charging System. (Commonwealth Edison Co., Chicago, Ill. (USA)). 6 Dec 1973. 5p. Dep. NTIS $3.00.

12285 (DOCKET-50305-132) KEWAUNEE NUCLEAR POWER PLANT. Final Report on Safety Injection Pump Modification. (Wisconsin Public Service Corp., Green Bay (USA)). 28 Nov 1973. 3p. Dep. NTIS $3.00.

12286 (DOCKET-50313-118) ARKANSAS NUCLEAR ONE, UNIT 1. Summary Report on Reactor Coolant Pump Motor Backstop Failure. (Arkansas Power and Light Co., Little Rock (USA)). 19 Nov 1973. 6p. Dep. NTIS $3.00.

12287 (DOCKET-50317-140) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Interim Report on Electrical Arc Damage to the Reactor Vessel. (Baltimore Gas and Electric Co., Md. (USA)). 26 Nov 1973. 2p. (DOCKET-50318-119). Dep. NTIS $3.00.

12288 (DOCKET-50317-142) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Deficiency Report: Failure of Battery Charger Surge Voltage Suppressors. (Baltimore Gas and Electric Co., Md. (USA)). 11 Dec 1973. 3p. (DOCKET-50318-121). Dep. NTIS $3.00.

12289 (DOCKET-50348-86) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Design Deficiencies in the Low Head Safety Injection System and the River Water System. (Alabama Power Co., Birmingham (USA)). 23 Nov 1973. 6p. (DOCKET-50364-75). Dep. NTIS $3.00.

12290 (DOCKET-50413-56) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. USAEC Final Environmental Statement. (Duke Power Co., Charlotte, N. C. (USA)). Dec 1973. 385p. (DOCKET-50414-56). Dep. NTIS $21.25.

The environmental effects of construction and operation of the Catawba Nuclear Station, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

12291 (DOCKET-50423-54) MILLSTONE NUCLEAR POWER STATION, UNIT 3. License Application, Environmental Report, Construction Permit Stage. (Millstone Point Co., Hartford, Conn. (USA)). 7 Feb 1973. 684p. Dep. NTIS $36.25.

The environmental effects of construction and operation of the Millstone Nuclear Power Station, Unit 3 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

12292 (DOCKET-50440-26) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. USAEC Draft Environmental Statement. (Cleveland Electric Illuminating Co., Ohio (USA)). Nov 1973. 231p. (DOCKET-50441-26). Dep. NTIS $13.75.

The environmental effects of construction and operation of the Perry Nuclear Plant, Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

12293 (DOCKET-50440-27) PERRY NUCLEAR POWER PLANT, UNITS 1 AND 2. Ichthyoplankton Survey in Lake Erie. (Cleveland Electric Illuminating Co., Ohio (USA)). 6 Nov 1973. 5p. (DOCKET-50441-27). Dep. NTIS $3.00.

12294 (DOCKET-50461-1) CLINTON POWER STATION, UNITS 1 AND 2. License Application. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 77p. (DOCKET-50462-1). Dep. NTIS $6.00.

The station, consisting of two BWR/6 type reactors is to be located in Harp Township, DeWitt County, Illinois near Clinton. Each of the two units is designed to operate at a rated power of 2894 MW(t) with a gross electrical output of 992 MW(e). Financial qualifications are given for the applicant. (FS)

12295 (DOCKET-50461-2) CLINTON POWER STATION, UNITS 1 AND 2. Antitrust Review Information Requested by the Attorney General. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 100p. (DOCKET-50462-2). Dep. NTIS $7.00.

12296 (DOCKET-50461-3) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 1. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 506p. (DOCKET-50462-3). Dep. NTIS $27.50.

Much of the material contained in the General Electric Standard Safety Analysis Report (GESSAR) for the BWR/6 type reactor is incorporated in this PSAR. Direct use of GESSAR is clearly identified. Information is presented concerning plant description, comparison with similar facilities; identification of agents and contractors; requirements for further technical information; material incorporated by reference; geography and demography; nearby industrial, transportation, and military facilities; and meteorology. (FS)

12297 (DOCKET-50461-4) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 2. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 494p. (DOCKET-50462-4). Dep. NTIS $26.75.

Information is presented concerning site meteorology, hydrologic engineering, geology, and seismology. (FS)

12298 (DOCKET-50461-5) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 3. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 452p. (DOCKET-50462-5). Dep. NTIS $24.75.

The design of structures, components, equipment, and systems

is described including conformance with AEC general design criteria; classification of structures, components, and systems; wind and tornado loadings; water level (flood) design; missile protection; protection against dynamic effects associated with postulated pipe rupture; seismic design; design of Category I structures; mechanical systems and components; seismic design of Category I instrumentation and electrical equipment, environmental design of mechanical and electrical equipment; separation criteria for safety-related mechanical and electrical equipment; and construction material standards and quality control procedures. Brief descriptions are given of the computer programs used for structural analysis and design. (FS)

12299 (DOCKET-50461-6) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 4. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 450p. (DOCKET-50462-6). Dep. NTIS $24.50.

The mechanical, nuclear, thermal, and hydraulic design of the reactor, and the control rod drive housing supports are described. Information on the reactor coolant system is presented including the integrity of the coolant pressure boundary, thermal hydraulic system design, reactor vessel and appurtenances, component and subsystem design, and instrumentation application. (FS)

12300 (DOCKET-50461-7) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 5. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 417p. (DOCKET-50462-7). Dep. NTIS $23.00.

Information is presented on the containment systems, ECCS, habitability systems, overpressurization system, main steamline isolation valves, control rod drive support systems, control rod velocity limiter, main steamline flow restrictor, standby liquid control system, and the reactor trip system. (FS)

12301 (DOCKET-50461-8) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 6. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 517p. (DOCKET-50462-8). Dep. NTIS $28.00.

Descriptions are presented concerning instrumentation and controls for the engineered safety features, safe shutdown systems, safety related and power generation display instrumentation, other systems required for safety and power generation, and other control systems. (FS)

12302 (DOCKET-50461-9) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 7. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 553p. (DOCKET-50462-9). Dep. NTIS $29.75.

Electric power systems associated with or contained within the nuclear station to provide power to nuclear-related loads as well as to other electrical loads are described. Information concerning auxiliary systems is presented including fuel storage and handling, process auxiliaries, heating, ventilation, and air conditioning. The steam and power conversion system, designed to produce electrical power from the steam coming from the reactor and including the turbine-generator and the main steam supply system is described. (FS)

12303 (DOCKET-50461-10) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 8. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 332p. (DOCKET-50462-10). Dep. NTIS $18.75.

Information is presented concerning the management of gaseous, liquid, and solid wastes; offsite, process, and effluent radiological monitoring; shielding; ventilation; the health physics program; the organizational structure of the applicant; training; emergency planning; review and audit; station procedures and records; industrial security; test programs; and augmentation of the staff for the initial tests and operation. (FS)

12304 (DOCKET-50461-11) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 9. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 460p. (DOCKET-50462-11). Dep. NTIS $25.00.

The ability of the plant to operate without undue hazard to the health and safety of the public is evaluated. Parameter variations caused by abnormal operational transients that threaten the integrity of the reactor fuel barrier or reactor coolant pressure boundary are discussed. Technical specifications are presented concerning safety limits and limiting safety system settings, limiting conditions for operation and surveillance requirements, major design features, and administrative controls. (FS)

12305 (DOCKET-50461-12) CLINTON POWER STATION, UNITS 1 AND 2. License Application, PSAR, Volume 10. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 264p. (DOCKET-50462-12). Dep. NTIS $15.25.

The quality assurance program to assure that the required effort, equipment, procedures, and management are provided during design, construction, and operation is presented. Nuclear safety operational analysis and the conformance to regulatory guides are included. (FS)

12306 (DOCKET-50461-13) CLINTON POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 1. (Illinois Power Co., Decatur (USA)). 26 Oct 1972. 429p. (DOCKET-50462-13). Dep. NTIS $26.75.

The environmental effects of the construction and operation of the Clinton Power Station are considered. Information is presented concerning requirements for power, consequences of delay, site location and layout, regional demography, land and water use, regional historic and natural landmarks, geology, hydrology, meteorology, ecology, and background radiological characteristics. (FS)

12307 (DOCKET-50461-14) CLINTON POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 2. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 386p. (DOCKET-50462-14). Dep. NTIS $21.50.

The environmental effects of construction, operation, and reactor accidents are presented. The effluent and environmental program are described. (FS)

12308 (DOCKET-50461-15) CLINTON POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 3. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 408p. (DOCKET-50462-15). Dep. NTIS $22.50.

The beneficial and adverse effects of the construction and operation of the Clinton Power Station on the environment are assessed. Alternate energy sources, sites, and plant design are evaluated. The social and economic effects of construction and operation; related benefits and costs; and environmental approvals are presented. (FS)

12309 (DOCKET-50461-16) CLINTON POWER STATION, UNITS 1 AND 2. Environmental Report, Volume 4. (Illinois Power Co., Decatur (USA)). 26 Oct 1973. 599p. (DOCKET-50462-16). Dep. NTIS $32.00.

Appendices to the environmental report concerning the following subjects are presented: wind speed and direction; water chemistry; phytoplankton, benthic invertebrate, and periphyton data; ground resistance; dose calculation models; LAKET program for predicting transient lake temperatures; radiochemical analytical procedures; employment study; consideration of potential reactor sites; cooling facilities; atmospheric effects of alternate cooling systems; regional benefits; press releases; basic data for source term calculations; and radiated electrical and acoustic noise on transmission lines. (FS)

12310 (DOCKET-50461-20) CLINTON POWER STATION, UNITS 1 AND 2. Construction Permit Stage, Environmental Report, Supplement 1. (Illinois Power Co., Decatur (USA)). 30 Oct 1973. 145p. (DOCKET-50462-20). Dep. NTIS $9.25.

12311 (DOCKET-50463-12) FULTON GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 7. (Philadelphia Electric Co., Pa. (USA)). 1973. 259p. (DOCKET-50464-12). Dep. NTIS $15.00.

12312 (DOCKET-50466-1) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 1. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 465p. (DOCKET-50467-1). Dep. NTIS $25.25.

Allens Creek Nuclear Generating Station is to be located in southern Austin County about 45 miles west of Houston. Single cycle forced circulation BWR type reactors will produce steam for direct use in steam turbines. Information concerning the station description, comparison with similar facilities, identification of agents and contractors, geography, demography, meteorology, and nearby industrial, transportation and military facilities is presented. The impact of the release of heat and moisture from the cooling lake is discussed in an appendix. (FS)

12313 (DOCKET-50466-2) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 2. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 318p. (DOCKET-50467-2). Dep. NTIS $18.00.

Hydrologic engineering information is presented concerning seismically induced dam failures; surge, seiche, tsunami, and ice flooding; cooling water canals and reservoirs, channel diversions, flooding protection, low water considerations, and environmental acceptance of effluents. (FS)

12314 (DOCKET-50466-4) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 4. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 401p. (DOCKET-50467-4). Dep. NTIS $22.25.

Site descriptions concerning geology and seismology are presented. Conformance with AEC general design criteria; classification of structures, components, and systems; and wind and tornado loadings are discussed. (FS)

12315 (DOCKET-50466-5) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 5. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 568p. (DOCKET-50467-5). Dep. NTIS $30.70.

Information is presented concerning missile protection; water level (flood) design; protection against effects associated with pipe rupture; seismic effects; design of category I structures, instrumentation, and electric equipment; seismic design of instrumentation and electrical equipment; mechanical systems and components; and environmental design. The mechanical, nuclear, hydraulic, and thermal design of the reactor and the control rod drive housing supports are presented. (FS)

12316 (DOCKET-50466-6) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 6. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 595p. (DOCKET-50467-6). Dep. NTIS $26.75.

The integrity of the reactor coolant pressure boundary, the thermal hydraulic system design, pressure vessel and appurtenances, reactor recirculation pumps, main steam line isolation system, core isolation system and core isolation cooling system, RHR system, water cleanup system, feedwater piping and drains, valves, and instrumentation requirements for the reactor cooling system are presented. The engineered safety features including the containment, ECCS, habitability and ECCS area exhaust system, are described. The instrumentation and the control of the reactor trip system are discussed. (FS)

12317 (DOCKET-50466-7) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 7. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 398p. (DOCKET-50467-7). Dep. NTIS $21.75.

Instrumentation and controls concerning the engineered safety features, safe shutdown systems, and safety related and power generation display systems are presented. (FS)

12318 (DOCKET-50466-8) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 8. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 425p. (DOCKET-50467-8). Dep. NTIS $23.25.

Information concerning instrumentation and control of refueling interlocks, the pressure vessel, process radiation monitoring, the process computer, reactor manual control, recirculating flow control, feedwater, and the pressure regulator and turbine is presented. The onsite and offsite electric power systems, fuel storage and handling and the water systems are described. (FS)

12319 (DOCKET-50466-10) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 10. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 500p. (DOCKET-50467-10). Dep. NTIS $27.00.

Information is presented concerning shielding, ventilation, the health physics program, organizational structure of the applicant, the training program, emergency planning, review and audit, plant procedures and records, industrial security, the test program, and staff augmentation for testing. Events caused by abnormal operational transients that threaten the integrity of the reactor coolant pressure boundary are analyzed to evaluate the ability of the reactor to operate without undue hazard to the health and safety of the public. (FS)

12320 (DOCKET-50466-11) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application, PSAR, Volume 11. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 548p. (DOCKET-50467-11). Dep. NTIS $29.50.

Technical specifications for safety limits and limiting safety system settings; limiting conditions for operation and surveillance requirements; major design features of the reactor, pressure vessel, containment, and fuel storage; and administrative controls are provided. The quality assurance program for design and construction is described. Appendices are presented concerning definitions used in the SAR, plant nuclear safety operational analysis, and exceptions to the AEC regulatory guides. (FS)

12321 (DOCKET-50466-12) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. License Application. (Houston Lighting and Power Co., Tex, (USA)). 5 Dec 1973. 74p. (DOCKET-50467-12). Dep. NTIS $5.75.

The license application for construction and operation of the Allens Creek Generating Station in Austin County, Texas is presented. The station will have two reactors, each of which will have an initial output of 3579 MW(t) (1200 MW(e)) with a design rating of 3758 MW(t) (1269 MW(e)). The application includes appropriate source, by-product, and special nuclear material licenses for the station. (FS)

12322 (DOCKET-50466-13) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. RO Inspection Report No. P-493/73-02. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 14p. (DOCKET-50467-13). Dep. NTIS $3.00.

12323 (DOCKET-50466-14) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. Antitrust Review Information Requested by the Attorney General. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 79p. (DOCKET-50467-14). Dep. NTIS $6.00.

12324 (DOCKET-50466-15) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Volume 1. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 594p. (DOCKET-50467-15). Dep. NTIS $31.75.

The environmental effects of construction and operation of the Allens Creek Nuclear Generating Station, Units 1 and 2, are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits–cost analysis of the proposed plant operation. (FS)

12325 (DOCKET-50466-16) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Volume 2. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 361p. (DOCKET-50467-16). Dep. NTIS $20.25.

12326 (DOCKET-50466-17) ALLENS CREEK NUCLEAR GENERATING STATION, UNITS 1 AND 2. Environmental Report, Volume 3. (Houston Lighting and Power Co., Tex. (USA)). 5 Dec 1973. 534p. (DOCKET-50467-17). Dep. NTIS $28.75.

12327 (DOCKET-50471-1) PILGRIM NUCLEAR POWER STATION, UNIT 2. License Application, Volume 1. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 571p. Dep. NTIS $30.75.

Pilgrim-2 Reactor located adjacent to Pilgrim-1 at the Pilgrim Generating Station in Plymouth, Massachusetts, consists of a PWR type reactor, turbogenerator and auxiliaries. Information concerning the applicants and their financial qualifications, cost estimates, description of the unit, nuclear indemnity protection, completion dates, security agreement, trade and news publication and communications is presented. (FS)

12328 (DOCKET-50471-2) PILGRIM NUCLEAR POWER STATION, UNIT 2. Antitrust Review Information Requested by the Attorney General, Volume 1. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 386p. Dep. NTIS $21.50.

12329 (DOCKET-50471-3) PILGRIM NUCLEAR POWER STATION, UNIT 2. Antitrust Review Information Requested by the Attorney General, Volume 2. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 326p. Dep. NTIS $18.50.

12330 (DOCKET-50471-4) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 1. (Boston Edison Co., Mass. (USA)). 20 Dec 1973. 512p. (DOCKET-50472-3). Dep. NTIS $27.75.

Information is presented concerning the plant design, comparison with other plants, identification of agents and contractors, requirements for further information, and material incorporated by reference. The reactor site geography; demography; hydrology; geology; seismology; and nearby industrial, transporation, and military facilities are described. (FS)

12331 (DOCKET-50471-5) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 2. (Boston Edison Co., Mass. (USA)). 1973. 407p. (DOCKET-50472-4). Dep. NTIS $22.50.

Information is provided on soil and seismic velocity measurements for the reactor site. (FS)

12332 (DOCKET-50471-6) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 3. (Boston Edison Co., Mass. (USA)). 1973. 477p. (DOCKET-50472-5). Dep. NTIS $26.00.

Design criteria for structures, components, equipment, and systems including conformance with AEC design criteria; classification of structures, components, and systems; wind and tornado loadings; water level (flood) design; missile protection; protection from pipe rupture; seismic design; mechanical system design; and

environmental design are provided. The mechanical, nuclear, thermal, and hydraulic design of the reactor are described. (FS)

12333 (DOCKET-50471-7) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 4. (Boston Edison Co., Mass. (USA)). 2 Jan 1974. 491p. (DOCKET-50472-6). Dep. NTIS $26.75.

The integrity of the coolant pressure boundary; thermal hydraulic system design; the reactor vessel and appurtenances; component and subsystem design including pumps, steam generators, piping, flow restrictors, steam line isolation system, RHR system, drain tank, and valves, and instrument application are described for the cooling system. Information is presented concerning the containment system, ECCS, habitability systems and the standby air filtration system. Appendices are provided describing the main steam line break analysis and compartment differential pressure analysis. (FS)

12334 (DOCKET-50471-8) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 5. (Boston Edison Co., Mass. (USA)). 1973. 480p. (DOCKET-50472-7). Dep. NTIS $26.00.

Instrumentation and controls which perform safety related functions are presented including descriptions of the plant protection system, reactor trip system, engineered safety feature system, systems required for safe shutdown, safety related display systems, safety related interlocks, and control systems not required for safety. Offsite and onsite electric power systems are discussed. (FS)

12335 (DOCKET-50471-9) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 6. (Boston Edison Co., Mass. (USA)). 1973. 351p. (DOCKET-50472-8). Dep. NTIS $19.75.

Descriptions are presented concerning fuel storage and handling, water systems, process auxiliaries, air conditioning, heating, cooling, ventilation, fire protection, communications, diesel generator fuel oil storage and transfer, diesel generator cooling water system, diesel generator starting and lubrication systems, turbine-generator, main steam supply system, main condenser, main condenser evacuation system, turbine gland sealing system, turbine bypass system, circulating water system, and the steam generator blowdown system. (FS)

12336 (DOCKET-50471-10) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 7. (Boston Edison Co., Mass. (USA)). 1973. 449p. (DOCKET-50472-9). Dep. NTIS $24.50.

Descriptions are presented concerning liquid, gaseous, and solid waste disposal. Process, effluent, and offsite radiological monitoring programs are explained. Radiation monitoring including shielding, ventilation, and the health physics program are described. The organizational structure, training program, emergency plan, review and audit, station procedures, plant records, and industrial security are discussed. Appendices included are on preoperation, precore hot functional, and postcore hot functional tests. (FS)

12337 (DOCKET-50471-11) PILGRIM NUCLEAR POWER STATION, UNITS 2 AND 3. License Application, PSAR, Volume 8. (Boston Edison Co., Mass. (USA)). 1973. 672p. (DOCKET-50472-10). Dep. NTIS $35.75.

Effects of malfunctions and failures within the facility are evaluated and their potential consequences are examined to determine their effect on the facility and to determine if the facility design is adequate to assure the health and safety of the public. Postulated events which normally result in no significant radioactive release at the exclusion boundary, events causing small or moderate release at the exclusion boundary, and events postulated in evaluating the design and performance of the facility and the acceptability of the site are described. Technical specifications including safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative controls are presented. Quality assurance during design and construction is discussed. (FS)

12338 (DOCKET-50472-1) PILGRIM NUCLEAR POWER STATION, UNIT 3. License Application. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 65p. Dep. NTIS $5.25.

Pilgrim-3 reactor, located at the Pilgrim Nuclear Generating Station at Plymouth, Massachusetts, consists of a PWR type reactor based on a unit core power level of 3456 MW(t) with a net electrical power output of about 1180 MW(e). Information concerning participation in the unit, cost estimates, financial qualifications, completion dates, publications, and communications is presented. (FS)

12339 (DOCKET-50472-2) PILGRIM NUCLEAR POWER STATION, UNIT 3. Antitrust Review Information Requested by the Attorney General. (Boston Edison Co., Mass. (USA)). 21 Dec 1973. 171p. Dep. NTIS $10.75.

12340 (DOCKET-RESARA-22) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume I, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Nov 1973. 323p. Dep. NTIS $18.25.

Information presented in RESAR-3 and its first four amendments is consolidated. The NSSS design and fabrication for a four-loop system consisting of a reactor and closed reactor coolant loops connected in parallel to the reactor vessel are described. Each loop contains a reactor coolant pump and a steam generator. The NSSS also contains an electrically heated pressurizer and certain auxiliary systems. The general plant description; plant comparison; identification of agents and contractors; requirement for further technical information; conformance with AEC design criteria; classification of structures, components, and systems; wind, tornado, and flood design criteria; missile protection; protection against dynamic effects associated with pipe rupture; seismic design; design of category I and II structures; mechanical systems and components; seismic design of safety related instrumentation and electrical equipment; and environmental design of mechanical and electrical equipment are described. (FS)

12341 (DOCKET-RESARA-23) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume II, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Nov 1973. 405p. Dep. NTIS $22.25.

Information concerning the mechanical, nuclear, thermal, and hydraulic design of the fuel rods and fuel assemblies, reactor internals, and the control rod drive mechanisms is presented. (FS)

12342 (DOCKET-RESARA-24) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume III, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Nov 1973. 427p. Dep. NTIS $23.50.

The reactor coolant system is described including the integrity of the coolant system boundary, thermal hydraulic system, reactor vessel and appurtenances, component and subsystems, and instrumentation application. Engineered safety features including the containment systems and the ECCS are presented. (FS)

12343 (DOCKET-RESARA-25) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume IV, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Apr 1973. 332p. Dep. NTIS $18.75.

Instrumentation and control systems providing automatic protection and exercising proper control against unsafe and improper reactor operation during steady state and transient power generation are described including the reactor trip system, engineered safety features actuation systems, systems required for safe shutdown, safety related display instrumentation, other systems required for safety, and control systems not required for safety. (FS)

12344 (DOCKET-RESARA-26) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume V, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Apr 1973. 375p. Dep. NTIS $20.75.

Descriptions are presented for auxiliary systems and radioactive waste management. Information is provided concerning fuel storage and handling; water systems; process auxiliaries; air conditioning, heating, cooling, and ventilation systems; liquid, gaseous, and solid wastes; and process, effluent, and offsite radiological monitoring programs. (FS)

12345 (DOCKET-RESARA-27) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume VI, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Jun 1972. 324p. Dep. NTIS $18.25.

Information is presented concerning the preoperational and initial start-up test programs, staff augmentation for initial test and operation, normal operation and operational transients, faults of moderate frequency, and infrequent faults. (FS)

12346 (DOCKET-RESARA-28) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume VII, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Oct 1972. 297p. Dep. NTIS $17.00.

Information concerning infrequent faults and limiting faults are presented with appendices which include time of break until occurrence of DNB, DNB until steam cooling, steam cooling period, verification of correlations used during steam cooling period, and the recovery phase of an accident. (FS)

12347 (DOCKET-RESARA-29) WESTINGHOUSE NUCLEAR ENERGY SYSTEMS. Reference Safety Analysis Report, Volume VIII, Amendment 5 (Consolidated Version). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). PWR Systems Div.). Apr 1973. 416p. Dep. NTIS $23.00.

Information is presented for technical specifications including safety limits and limiting safety system settings, limiting conditions for operation, surveillance requirements, design features, and administrative control. The quality assurance program during design and construction is described. (FS)

12348 (DOCKET-STN-50470-1) PWR NUCLEAR STEAM SUPPLY SYSTEM 80. PSAR, Volume 1. (Combustion Engineering, Inc., Windsor, Conn. (USA)). 18 Dec 1973. 613p. Dep. NTIS $32.75.

A standard safety analysis for a PWR system 80 rated at 3800 MW(t) is presented. This system provides for two coolant loops and a core composed of 89 control assemblies and 241 fuel assemblies. The fuel is low-enriched UO_2 pellets encased in pressurized Zircaloy tubes. Reactivity control is provided by a control element drive system (for short term reactivity changes and rapid shutdown) and a chemical and volume control system (for long term reactivity changes and to make the reactor subcritical without using the control rod drive system). Information is presented for the reactor site; design of structures, components, equipment, and systems; reactor; and the reactor coolant system and related systems. (FS)

12349 (FIND-50412) FIND: BEAVER VALLEY POWER STATION, UNIT 2. Items 1-37. Carter, E. P. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1973. 22p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc. and refer to grid coordinates on microfiche sheets prepared for each docket report. (auth)

12350 (RAI-73-11) REGULATORY ADJUDICATION ISSUANCES, NOVEMBER 1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). 15 Dec 1973. 72p. TIC $1.25.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

12351 (WASH-1284) GUIDANCE ON QUALITY ASSURANCE REQUIREMENTS DURING THE OPERATIONS PHASE OF NUCLEAR POWER PLANTS. (USAEC, Washington, D. C.). 26 Oct 1973. 140p. Dep. NTIS $9.00.

AEC regulations, regulatory guides, and extracts from a draft standard which provide requirements and guidance on the quality assurance program during the operations phase of nuclear power plants are included. One draft regulatory guide, "Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors," is presented. This guide is in the process of being printed and is expected to be issued on approximately November 16, 1973. A draft of this guide was reviewed by the ANS-3 Subcommittee and their comments were considered in the previous guide. (auth)

12352 QUICKER CONSENT IS THE MOTIVE FOR FLOATING NUCLEAR POWER STATION. McHugh, B. (Chalmers Tekniska Hoegskola, Goteborg). Tek. Tidskr.; 103: No. 10, 31-33(25 May 1973). (In Swedish).

It is proposed to build a 2×1150 MW nuclear power station on a floating platform anchored 5 km off the coast of New Jersey. This would obviate environmental objections and reduce the time taken to obtain official consent for the construction of the station. A Swedish firm (Kockums) is collaborating with other organizations in the Association Européenne Océanique in a similar project to construct floating power stations in the Mediterranean, the North Sea, and the Baltic. Two similar modules would be anchored within a breakwater having a total mass of 3×10^6 tons. (SW)

GENERAL

Civilian Defense

Refer also to abstract 12028.

12353 (ORNL-4860) EXPEDIENT SHELTERS SURVEY. Final Report. Cristy, G. A. (Oak Ridge National Lab., Tenn. (USA)). Jul 1973. 186p. Dep. NTIS $7.60.

This report reviews the state of the art of expedient shelter building and develops a recommended list of shelters to include in an adequate expedient shelter manual for assistance to civil defense planners and for persons who may have to build such shelters in the USA. (75 references) (CH)

12354 (ORNL-4903, pp 144-165) STRATEGIC DEFENSE. Chester, C. V.; Cristy, G. A.; Gailar, J. S.; Haaland, C. M.; Heath, M. T.; Kearny, C. H.; Manweiler, R. W. Sep 1973.

In Health Physics Division annual progress report for period ending July 31, 1973.

Information available on the current Soviet civil defense program is summarized, with emphasis on comprehensive population evacuation and dispersal plans during periods of escalating crisis, the inauguration of civil defense training in the second grade in schools throughout the Soviet Union, emphasis on decreasing the vulnerability of vital industries, and provisions for shelters for protection against fallout from nuclear weapons. Strategic, economic, and political considerations in planning countermeasures against nuclear attack in the USA are discussed with emphasis on the feasibility of the evacuation of urban populations, the availability of passenger transportation, population density, and surveys of shelter availability, effectiveness, and the availability of materials needed for shelter construction and occupation. (CH)

Energy Utilization and Economics

12355 (BNWL-1801) STUDY OF HANFORD CAPABILITY FOR SOLAR ENERGY RESEARCH AND DEVELOPMENT. Drumheller, K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-1830. 55p. Dep. NTIS $5.45.

The Hanford site provides unique capability for solar energy research and development. The basic attributes include large available land areas; consistent sunshine during much of the year (although not comparable to Arizona and the southwest U. S.); extreme temperatures for test purposes (−27 to 115 F); cooling water availability; ecology approximating ecology in some other solar areas; R&D facilities applicable to most solar technology; equipment immediately useful for solar energy programs; technology background in most areas of solar energy; experience with large energy systems, and background in systems analysis. From the solar energy production standpoint, the energy that falls on the 600 square miles at the Hanford site would produce 100,000 megawatts if 33⅓% efficiency can be achieved. (MCW)

12356 (JPRS-60546) MATHEMATICAL METHODS OF OPTIMAL PLANNING DEVELOPMENT AND USE OF ENERGY SYSTEMS. Padalko, L. P. 15 Nov 1973. Translation of Matematicheskie Metody Optimal'nogo Planirovaniya Razvitiya i Ekspluatatsii Energosistem, Izdatel'stvo Vysheyshaya Shkola, Minsk, 1973. 208p. NTIS.

A discussion of the bases of mathematical methods of optimal planning and their use for selecting optimal solutions in the planning, development, and operation of power supply systems is presented. (JPRS)

12357 (JPRS-60584) FROM SCIENTIFIC RESEARCH TO THE ATOMIC INDUSTRY. Petros'yants, A. M. (Joint Publications Research Service, Washington, D. C. (USA)). 19 Nov 1973. Translated from pp 31-74; 81-203; 211-219; 270-324 of Ot Nauchnogo Poiska k Atomnoi Promyshlennosti, Atomizdat, Moscow, 1972. 224p. NTIS.

The report contains excerpts from a book tracing the evolution of the nuclear power industry from the research stage to its present-day development. Topics discussed include high-energy physics, thermonuclear fusion, electric power engineering, small and low-power nuclear power plants, prospects of nuclear power engineering, radioactive waste disposal, and nuclear centers. (JPRS)

12358 (N-73-26818) ASSESSMENT OF SOLAR ENERGY AS A NATIONAL ENERGY RESOURCE. Donovan, P.; Woodward, W.; Cherry, W. E.; Morse, F. H.; Herwig, L. O. (Maryland Univ., College Park (USA). Dept. of Mechanical Engineering). Dec 1972. 89p. (NASA-CR-133101). NTIS $6.50.

The applications are discussed of solar energy for thermal energy for buildings; chemical and biological conversion of organic materials to liquid, solid, and gaseous fuels; and the generation of electricity. It is concluded that if solar development programs are successful, building heating for public use is possible within 5 years, building cooling in 6 to 10 years, synthetic fuels from organic materials in 5 to 8 years, and electricity production in 10 to 15 years. (STAR)

12359 (NTIS-WIN-73-13) COAL GASIFICATION. A Bibliography With Abstracts. Lehmann, E. J. (National Technical Information Service, Springfield, Va. (USA)). Jul 1973. 52p.

This bibliography contains 51 selected abstracts of research reports retrieved using the NTIS on-line search system — NTISearch. The topics included cover all aspects of coal gasification that concern the use of coal gas as a fuel or feedstock. Desulfurization of coal by gasification is not covered unless the use of the gas is discussed. Also presented are in situ combustion studies on removing coal from its deposits by underground gasification. (auth)

12360 (NTIS-WIN-73-17) DESULFURIZATION OF COAL AND PETROLEUM. A Bibliography With Abstracts. Harrison, E. A. (National Technical Information Service, Springfield, Va. (USA)). Jun 1973. 78p.

This bibliography contains 78 selected abstracts of research reports retrieved using the NTIS on-line search system — NTISearch. The abstracts are divided into two sections. The first contains 59 reports on all aspects of coal desulfurization, whereas the second section contains 19 abstracts dealing with petroleum desulfurization. (auth)

12361 (ORNL-EIS-73-65(Rev. 1)) ENERGY RESEARCH AND DEVELOPMENT. A Selected Reading List. Guthrie, M. P.; Huber, E. E.; Norwood, G. A. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. 99p. Dep. NTIS $7.60.

A listing of 1205 selected readings was assembled to aid policymakers in the identification of areas for energy research and development. A perspective was necessary on the state of energy research and development to support the development of a report to the President from the Chairman of the AEC on long-range energy research and development needs and policy. The bibliography includes general publications on energy sources, electric power, generation, energy uses, and Congressional publications related to energy. The use of the permuted index on titles is included. An author index is given. (MCW)

12362 (UCID-16386(Pt. 1)) ECONOMICS OF THERMODYNAMIC SOLAR POWER SYSTEMS. I. The Efficiency Function. Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Sep 1973. Contract W-7405-eng-48. 12p. Dep. NTIS $3.00.

Thermodynamic schemes are being studied for central power systems having early applicational viability. The TD schemes universally involve an extensive thermal subsystem (that collects the solar flux and delivers its energy as heat) coupled to a central thermodynamic subsystem (that converts the heat to work). Various degrees and models of storage may be invoked to supply power beyond the mere solar day, in time. The complete economic situation is examined in view of the present inflationary condition. The various solar collector field concepts exhibit capital costs running between $900 to $2500 per kw. The central plant equipment includes heat exchangers, turbo-generators, pumps, and other TD machinery, at $50 to $150 per kw; storage schemes reflect $50 to $200 per kw. (MCW)

12363 (UCID-16386(Pt. 2)) ECONOMICS OF THERMODYNAMIC SOLAR POWER SYSTEMS. II. The Turbine Trade-Off. Wouters, L. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1973. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.

It has been indicated that a more expensive, higher efficiency thermodynamic subsystem could result in a less-expensive, more "cost-effective" solar power system, overall. It is interesting to see how severe a trade-off this really is. A primitive two-component system model consisting of (1) the collector and (2) the turbine was constructed. Of course there are lots of other pieces between and around these items, but these two are the ones to which most "cost leverages" can be associated, in some way. A given collector design is assumed, having a defined specific efficiency and unit area cost. The turbine efficiency is varied parametrically from a reference value, and an allowable cost trade-off as a ratio to reference turbine price is obtained. No attempt is made to relate a particular cost change to a particular

design change. The maximum that can be afforded for any and all changes is established. (auth)

12364 (UCRL-51469) ANALYSIS OF THE WINDS OF SITE 300 AS A SOURCE OF POWER. Archibald, P. B. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 23 Oct 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $4.00.

Site 300 is a strategically located area lying east of the Lawrence Livermore Laboratory at Livermore, California. The prevalent wind is from the west; its driving force is the pressure gradient between the hot interior valleys and the cool marine air of the Pacific Ocean. Wind measurements indicate that this is a good site for electrical power generation. (auth)

12365 (WASH-1281) NATION'S ENERGY FUTURE. A Report to Richard M. Nixon, President of the United States. Ray, D. L. (USAEC, Washington, D. C.). 1 Dec 1973. 182p. GPO $1.95.

This report, developed under the general guidance of the Energy Policy Office, is in response to the directive of the President on June 29, 1973, to the Chairman of the Atomic Energy Commission to review Federal and private energy R and D and to recommend an integrated program for the Nation. The report is based largely on the results of: (1) a group of Energy Workshops organized under the sponsorship of Cornell University, (2) sixteen Technical Review Panels of 121 Federal employees from 36 Departments and Agencies assisted by 282 consultants from the private sector, and (3) an Overview Panel that reviewed the results from the Workshops and Technical Panels. A draft of the report was sent to more than 100 individuals for comment, as well as to all concerned government Departments and Agencies. In addition, Dr. Ray consulted personally with numerous leaders in government, industry, and the scientific community throughout the period of the Report's preparation. Specifically, the report recommends: (1) a national energy R and D program, (2) a five-year, $10 billion Federal energy R and D program, and (3) the FY 1975 Federal budget for energy R and D. The recommended program, based on what is now known, is both necessary and sufficient to maximize energy R and D's contribution to the Nation's energy goals; even so, 1985 is the earliest date by which self-sufficiency can reasonably be expected. By 1980, the recommended program can reduce oil imports to half those currently projected; other extraordinary measures will be required to displace the other half. (LMT)

12366 DEPENDENCE OF THE EFFICIENCY OF A BRIGHTON GAS TURBINE CYCLE ON THE PROPERTIES OF THE WORKING MEDIUM. Smal'ko, A. A.; Tetel'baum, S. D.; Klok, A. M. Therm. Eng. (USSR) (Engl. Transl.); 20: No. 1, 108-110(Jan 1973).

Translated from Teploenergetika; 20: No. 1, 77-78(1973).

Computations were made for the efficiency of a gas turbine cycle using the properties of an ideal gas. Calculations were then specifically made for a CO_2 + He mixture. Air, nitrogen, helium, CO_2, or mixtures may be used as the working medium. The power output may be controlled in a closed system gas turbine plant by varying the temperature of the working medium at the turbine inlet and the mass of the working medium in the plant. In this case, irrespective of change in temperature, the pressure of the working medium must vary due to the change in its mass circulating in the plant circuit. Results show that the closer the properties of the working medium are for a closed-cycle gas turbine plant to the properties of an ideal gas, the higher the economic stability of the plant. (MCW)

12367 FREQUENCY RESPONSE OF A SUPERCONDUCTING TRANSMISSION LINE. Campbell, C. K. (McMaster Univ., Hamilton, Ont.). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 6, 799-800(Jun 1973).

A two-element equivalent circuit for the surface impedance of a superconductor is considered in approximations of the frequency response of a superconducting transmission line. It is shown that the model yields good approximate agreement with more rigorous derivations applied to classical or anomalous normal conductivities, as well as to nonlocal conduction effects. (auth)

12368 US ENERGY OUTLOOK. Nuclear Energy Availability. Washington, DC; National Petroleum Council (1973). 156p.

The National Petroleum Council's Initial Appraisal assumed a continuation of the general government policies and economic climate in effect in 1971. In this context, installed nuclear electric power generating capacity was projected to attain a level of 150,000 megawatts (MWe) in 1980 and 300,000 MWe in 1985. In order to assess the capability of the nuclear industry to provide more energy and to take into account possible changes in government policies and the economic climate, this study has developed projections for a maximum growth rate of nuclear electric power (Case I, 450,000 MWe installed in 1985), a minimum growth rate (Case IV, 240,000 MWe in 1985), and two intermediate growth rates (Case II, 375,000 MWe in 1985 and Case III, 300,000 MWe in 1985). The four different rates of growth were then further projected to the year 2000 in order to establish the requirements for the development of forward reserves of uranium and thorium in 1985 and to establish a basis for qualitative analysis of trends in supply of nuclear energy to the end of the century. (auth)

12369 METHOD FOR FEEDING DRY COAL TO SUPERATMOSPHERIC PRESSURE. Hoffert, F. D.; Stotler, H. H. (to Hydrocarbon Research, Inc.). US Patent 3,775,071. 27 Nov 1973. Filed date 20 Jul 1971. 4p.

A method for continuous feeding of dry coal particles from essentially atmospheric pressure to the superatmospheric pressure level of a coal gasifier or coal liquefaction reactor is achieved by a series of screw feeding devices each partially boosting the pressure level of the coal in stages to provide the dry coal at reactor pressure. (Official Gazette)

12370 GAS PRODUCTION. White, R. J. (to Chevron Research Co.). US Patent 3,775,072. 27 Nov 1973. Filed date 14 Dec 1970. 8p.

A process is given for producing high Btu gas which comprises contacting an organic feed material, containing hydrogen and at least 10 wt.% oxygen, with steam in a reaction zone in the presence of an alkali metal catalyst at an elevated temperature and an elevated pressure of at least 50 psig. It is particularly preferred to carry out gasification of the organic material at a pressure above 300 psig. Particularly preferred catalysts are potassium compounds, most preferably potassium carbonate. Preferred reaction temperatures are between 1200 and 1400°F. (Official Gazette)

12371 GAS TURBINES FACE NEW CHALLENGES. Papamarcos, J. Power Eng.; 77: No. 12, 30-37(Dec 1973).

Gas turbines continue to increase the electric power generation market in both the peaking and the intermediate load categories. With the increase in unit size and operating efficiencies, capital costs per kilowatt are reduced. Clean fuels—gas, light oil, or alcohol-type fuel—are needed for the gas turbines. The most efficient method of power generation is now attained from gas turbines, but the shortage of clean fuels looms. Manufacturers are anticipating the availability of clean fuels and continue working on the development of high-pressure, high-temperature turbines. In the near-term, increased efficiency is sought by making use of the turbine exhaust heat, involving combined or regenerative cycles. (MCW)

12372 ENERGY POLICY AND ENVIRONMENTAL PROTECTION IN EUROPE. Michaelis, H. Energiewirt. Tagesfragen; 23: No. 9/10, 492-497(1973). (In German).

The introductory review of the specialist meeting "Energy Supply and Environmental Protection as European Tasks" that took place in Mannheim on June 18-19, 1973 is given. In the section energy economy and energy policy, the report especially deals with the security of supply in Europe, i.e., in particular the position on the petroleum market. In further sections, the most important ideas on the topics endangering the environment and environmental protection, as well as the conflict between the aim to secure energy supply and have optimum environmental protection are discussed. (GE)

12373 POWER INDUSTRY OF THE PEOPLE'S REPUBLIC OF CHINA. Harnisch, H.; Gloria, H. G. Essen; Glueckauf (1973). 141p. (In German).

Following a general survey of the mineral and fuel resources of the Chinese Mainland, a review is given of the overall economic development of the People's Republic of China. The development of the coal industry and the mineral, oil, and natural gas industries, as well as the economic utilization of water power and the developmental state of the nuclear industry are dealt with in detail. The existing fuel and energy resources and their effect on the siting of industrial plants and on transportation in general are discussed. Data on important coal, mineral, oil and natural gas deposits are shown in numerous tables. (GE)

12374 STEAM TURBINES OF 125/135 MW CAPACITY FOR NEW DISTRICT HEATING PLANTS OF BUCHAREST. Vaclavova, A. Skoda Rev.; No. 3, 13-24(1973).

Four 125- to 135-MW extraction turbines are being installed in Bucharest for new district heating plants. They are patterned after the Skoda condensing extraction turbo-sets in the Danish district heating plant of Amagervaerket and the 110-MW condensing units in Ludush and Craiova. All principal technical specifications are given and diagrams of many sections are illustrated. (MCW)

12375 PROBLEMS OF CENTRALIZED HEAT SUPPLY FROM NUCLEAR HEAT AND POWER STATIONS. Bunin, V. S. Therm. Eng. (USSR) (Engl. Transl.); 19: No. 9, 103-107(Sep 1973).

Translated from Teploenergetika; 19: No. 9, 69-73(1972).

The problems associated with using a nuclear power plant as both a heat and power plant, i.e., for generating steam for centrally heating a community as well as for generating electric power, are discussed. (LCL)

12376 IMPROVEMENTS IN OR RELATING TO THE TREATMENT OF GASES. Nicklin, T. (to British Gas Corp.). British Patent 1,331,561. 26 Sep 1973. Filed date 11 Mar 1971. 4p.

A method is described for removing SO_2 from gaseous effluents. The gas stream is passed with H_2 through a catalyst bed to produce an H_2S-containing gas, and the latter is passed with air through a second catalyst to induce conversion of the H_2S to elemental S, which is condensed and removed. The gas is then passed to an H_2S stripping stage. Catalysts employed may be oxides of U, Th, Ni, Mo, Ae and Co, or mixtures thereof, and the H_2S stripping stage may employ a ZnO absorber, or the gas may be washed with a solution of sodium vanadate and the disodium salt of anthraquinone disulphonic acid. (UK)

12377 CANADA SWINGS TOWARD NUCLEAR ENERGY BASE. Energy Int.; 10: No. 9, 32-33(Sep 1973).

Nuclear energy growth in Canada was a dramatic topic at the 1973 annual conference of the Canadian Nuclear Association meeting. Ontario Hydro will proceed almost immediately with a construction program that will add a further 8000 MW of nuclear capacity to their system between 1979 and 1984. Ontario government promises to locate a nuclear station at a Great Lakes border point and sell the power to U. S. utilities. The contract between Hydro-Quebec and AECL was still unsigned, but engineering was proceeding as if Gentilly-2 were a fully committed project. New Brunswick will probably be the third Canadian province to host a nuclear station. A forecast of the national market for nuclear power was predicted to be 133.600 GW by the year 2000. This estimate assumed a continuing 7% annual growth in total capacity with the component increasing to 45%. A moderately intensive installation program would give Ontario Hydro a nuclear capacity of 62.800 GW out of a total of 100 GW. The economics of the investments is discussed. (MCW)

12378 UHV POWER LINES CAN BE BUILT NOW. Denbrock, F.; Shah, K. R. Energy Int.; 10: No. 12, 19-21(Dec 1973).

American utilities are preparing for voltages up to 1500 kV to meet the demand for bulk energy transfer. Power transmission at the uhv is feasible and the technology for designing line, equipment, and substations for these levels is available. Aesthetically acceptable structures can be designed to minimize the impact of the line on the environment. Electrical radiation criteria, the National Electric Safety Code, switching surge flashovers, and heavy mechanical loadings will be used to optimize uhv transmission-line design parameters so as to minimize radio and television interference, ozone generation, audible noise emission, and induced voltages on nearby structures. (MCW)

12379 AEP THWARTED IN SEARCH FOR FLUE GAS CLEANING SYSTEM. Jeffs, E. (ed.). Energy Int.; 10: No. 12, 28(Dec 1973).

Air pollution control legislation, particularly in West Virginia, poses a serious threat to one of the country's largest utilities, American Electric Power System. Alternatives include switching to low-sulfur coal transported from western USA, shut down the offending plants and rely on energy imports from neighboring utilities and their own nuclear and hydro capacity, or fit flue-gas cleaning systems and burn the same fuel. There is no proven SO_2 removal system in operation anywhere in the world that can meet the stringent requirements of utility operation; a Battelle Institute study confirmed this. Turning to western coal may become snagged if the Senate passes an amendment that seeks to prohibit surface mining of coal on property where the mineral rights are owned by the Federal Government. Some 15 billion t of low-sulfur coal would be denied to the utilities. (MCW)

12380 ENERGY RESEARCH AND DEVELOPMENT. Ninety-Third Congress, First Session, December 1, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 63p. GPO.

The Committee on Interior and Insular Affairs issued the report on a bill to establish a national program for research, development, and demonstration in fuels and energy and for the coordination and financial supplementation of Federal energy research and development; to establish development corporations to demonstrate technologies for shale oil development, advanced power cycle development, geothermal steam development, and coal liquefaction and gasification development; to authorize and direct the Secretary of the Interior to make mineral resources of the public lands available for the development corporations. Comments from governmental agencies on the bill are published. (MCW)

12381 SUMMARY OF PROCEEDINGS. Conference on Health Effects of Air Pollution, National Academy of Sciences, October 3-5, 1973, Ninety-Third Congress, First Session. Prepared for the Committee on Public Works, United States Senate, November, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 40p. GPO.

Under provisions of Senate Resolution 135, the Committee on Public Works contracted with the National Academy of Sciences (NAS) for an evaluation and review of current data on the health effects of major air pollutants. Twenty-two scientists reviewed the biological effects of the four major classes of pollutants before the NAS Conference on Health Effects of Air Pollutants, Oct. 3-5, 1973. Included here are summaries of data on carbon monoxide; sulfur oxides and particulates; nitrogen oxides; hydrocarbons and oxidant; and mutagenesis and carcinogenesis. (MCW)

12382 UNIVERSITY ENERGY RESEARCH CENTERS. Hearing Before the Subcommittee on Energy of the Committee on Science and Astronautics, U. S. House of Representatives, Ninety-Third Congress, First Session, on H. R. 8348 and H. R. 9133, July 23, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 52p. GPO.

Hearings on a bill to authorize the NSF to designate certain institutions of higher education as national energy research centers reflect the growing importance of energy research and development in meeting the energy crisis that the Nation faces. The hearings show the importance of research activities at universities in developing the knowledge that underlies new energy technology. The statements of three witnesses are included. A conference paper given Jan. 31, 1973 at the IEEE Power Engineering Society 1973 Winter Meeting by Dr. H. H. Woodson, a witness at the hearings, was included in the document. (MCW)

12383 ENERGY RESEARCH AND DEVELOPMENT: AN OVERVIEW OF OUR NATIONAL EFFORT. Hearing Before the Subcommittee on Energy of the Committee on Science and Astronautics, U. S. House of Representatives, Ninety-Third Congress, First Session, May 15, 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 51p. GPO.

The introductory statement by Congressman Mike McCormack was read at the overview panel meeting. Dr. H. Guyford Stever was the initial witness of the representatives of the NSF to present a statement. The speakers covered all facets of energy technology. NSF objectives are to analyze the intermediate and long-range problems associated with energy. The programs in energy conversion stress increased efficiency in converting energy from the forms in which it occurs in nature to forms that are cleaner and more convenient to use. The NSF was elected as the government agency to take the lead in research in solar energy. A statement was included that dealt with the participation of NASA in the NSF/RANN program. (MCW)

12384 OCCIDENTAL DEVELOPS LOW-COST SNG ROUTE. Chem. Eng. News; 51: No. 51, 23-24(17 Dec 1973).

A subsidiary of Occidental Petroleum Co., Garrett R & D Co., along with Colorado Interstate Gas Co., has developed a low-pressure pyrolysis system for the development of producing pipeline gas from coal. The Garrett process is based on the concept of partial gasification of coal in which the optimum yield of methane and other hydrocarbons is obtained by rapid pyrolysis of pulverized coal. The method eliminates the need for either an inert heating medium or an auxiliary oxygen plant. The Garrett process is perhaps suitable for integration with a large power plant. Assuming that the present development schedule continues, Garrett expects to go on stream with a commercial plant within six years. (MCW)

12385 LEST DARKNESS FALL. Padrutt, A. L. Pub. Util. Fortn.; 92: No. 13, 20-24(20 Dec 1973).

An historical and philosophical commentary on the background of the energy crisis and its interdependence on environmental considerations is presented. The author cites the urgency of the present crisis as learned from data of federal agencies. The steady march of energy development is followed. The role of labor in past civilizations is cited, and it could be said that man's newly found ability to utilize the energy stored in fossil fuels has, in 100 years, done more to liberate and dignify the individual than has anything else. Utilities are facing serious problems. Other problems discussed are inflation, consumer activism, and militant environmentalism. Adoption of the President's energy messages to Congress is necessary for a short-term solution. As a long-term solution, the breaking of the technical barriers involving the fusion of the atom and the tapping of solar energy is necessary. (MCW)

12386 UTILITY FINANCING IN AN AGE OF INFLATION. McDiarmid, F. J. Pub. Util. Fortn.; 92: No. 13, 25-30(20 Dec 1973).

The golden age of public utility financing in America lasted from the late 40's to about 1966. An examination was made of the statistical evidence and it is concluded that, in the absence of an unlikely halt of inflation, the present return on book equity will not be sufficient to enable the utilities to carry out their public service obligations. Their future will depend on earnings that will attract new capital without diluting present investment. (auth)

12387 TIME FOR A NEW TRANSFORMER TEST SPECIFICATION. Energy Int.; 10: No. 12, 16-18(Dec 1973).

Experience has shown that to build and test a large transformer in strict accordance with national or international specifications no longer constitutes a sufficient assurance of satisfactory performance in service. The purchaser must fully inform the manufacturer what is required and the designer will provide it one way or another. A measure of agreement exists on maximum rating at any given voltage of a unit that could be transported within some assumed weight limitation. One form of construction permits the transformer to be dismantled for transport and re-assembly on site. There is growing pressure to minimize weight and costs. Reasons are discussed concerning the fact that large transformers are not as reliable as their predecessors of some years ago. (MCW)

12388 INDIA LAUNCHES PROGRAMME TO FIGHT POWER SHORTAGE. Energy Int.; 10: No. 12, 26(Dec 1973).

Power expansion in India is discussed and seventeen new energy projects are indicated for 1973–1974. The units will add 2100 MW to the present generating capacity. Big additions will include 500 MW in the northern regions, a 300 MW extension at the Badarpur Thermal Plant, and 324 MW in the western region. The three nuclear power plants are at Tarapur, Rana Pratap Sagar, and Kalpakkam. A fourth station is planned at Narora in northern India. (MCW)

12389 STATIC CONVERTER STARTING GIVES ECONOMY TO PUMPED STORAGE. Armbruster, T. F.; Haboeck, A.; Brueckl, H. Energy Int.; 10: No. 9, 12-14(Sep 1973).

Static converter starting systems were developed using a dc link to minimize disturbances in a utility system during start-up of large pumped-storage sets. Such a system, designed by Siemens AG, is being supplied with four Allis Chalmers' reversible pump turbines to the Tennessee Valley Authority's Raccoon Mountain pumped storage project. The advantages of static starting over direct connected auxiliary devices are reduced headroom resulting in lower construction costs, improved efficiency due to elimination of windage losses on the auxiliary device, and reduced maintenance. Compairing with motor-generator starting, the advantages also include reduced maintenance, improved efficiency, and higher availability. The lower weight reduces installation freedom. Another advantage is the reduced plant starting time due to elimination of the deceleration time of the motor generator set as well as any cooling period required between starts. The method used with a dc link control is relatively simple and is suitable for slow starting processes such as those required for start-up of large units. (MCW)

12390 AIR STORAGE: THE ALTERNATIVE PEAK POWER SOURCE. Jeffs, E. Energy Int.; 10: No. 9, 23-25(Sep 1973).

The need for energy storage is increasing with the advent of more nuclear power plants. Where lack of water or unsuitable terrain rule out pumped storage, air storage systems based on gas-turbine technology provide an economic and easily deployed alternative. Unlike a conventional gas-turbine generator package, the compressor and turbine stages are mounted on separate shafts at opposite ends of a motor-generator set and coupled to it via clutches. At night the compressor is coupled to the electrical machine, which functions as a motor. The compressor feeds air at high pressure into an underground storage cavern. In the daytime peak periods the turbine is coupled to the machine that now serves as a generator. Air is discharged from the cavern, into a combustion chamber and then to the power turbine. Some preheating of the air can be arranged by means of an exhaust heat recuperator. The storage cavern is excavated beneath a lake, or the sea, so that a constant air pressure can be maintained by hydrostatic means. If no water is available, air can be delivered at constant volume over a decreasing pressure range. (MCW)

12391 AMERICAN IMPORT POLICY AND THE WORLD OIL MARKET. Adelman, M. A. (Massachusetts Inst. of Tech., Cambridge). Energy Policy; 1: No. 2, 91-99(Sep 1973).

Little effect will be seen for self-sufficiency before 1980, when imports are expected to reach 10 million barrels/day. There is no danger of the U. S. bidding away scarce oil. First, it has no power to do so. The American and other multinational oil companies take orders from the producing nations, no matter who owns them. Second, oil continues as before in great potential over-supply, which the growing price–cost gap will aggravate. Price and availability of world oil unrelated to supply and demand, high prices and insecure supply, and Middle East politics irrelevant to security of price are discussed. (Note: This article was written before the Arab oil embargo). (MCW)

12392 WORLD ENERGY PROBLEMS AND JAPAN'S INTERNATIONAL ROLE. Sakisaka, M. (Inst. of Energy Economics, Tokyo). Energy Policy; 1: No. 2, 100-106(Sep 1973).

A need exists for reliable, secure supplies of oil, and these supplies are being threatened by the governments of the oil-producing countries turning from mere collectors of tax from the oil industry to control. Growing nationalism is strengthening their hold over the oil industry through nationalization of the industry on their soil, participation in oil business, and conservation of resources. The main energy consuming countries need to establish mutual understanding, ways of cooperating, and coordination of their policies, but this is hard to do in countries with different interests. A global and long-range energy program needs to be established. Most of the oil in the Asia–Pacific region is from the Middle East and Japan's role is discussed. Japan should participate in the technological development necessary for new energy sources. The industrially advanced nations are obliged to rescue mankind from the energy crisis by finding efficient uses of energy. (MCW)

12393 FUTURE GROWTH OF NUCLEAR POWER. Part 1. Demand and Supply. Surrey, A. J. (Univ. of Sussex, Brighton, Eng.). Energy Policy; 1: No. 2, 107-129(Sep 1973).

Uncertainty surrounds the development of nuclear power in the 1980's. Projections of growth suggest that the nuclear generating capacity of the non-Communist countries will reach 250,000 to 300,000 MW(e) in 1980, 500,000 to 650,000 MW(e) in 1985, and 900,000 to 1,200,000 MW(e) in 1990. A serious reactor failure or increasing public concern for siting and safety could be detrimental. The market structure of the nuclear plant supply is evolving rapidly. Manufacturing lead times are long and orders are irregular. Nuclear fuels have a more complex supply structure than the plants. The USA has yet to decide when to build additional enrichment facilities and who should control them. (MCW)

12394 US ENERGY CRISIS: A SCIENTIST'S VIEW. White, D. C. (Massachusetts Inst. of Tech., Cambridge). Energy Policy; 1: No. 2, 130-135(Sep 1973).

Energy consumption in the U. S. has increased 18-fold during the last 100 years. The increase resulted from growth in domestic consumption and private transport, goods requiring more and more energy in production and distribution, and essential energy-dependent services. The author argues that the crisis is a political and economic one and that growing energy consumption, dwindling domestic reserves, and environmental disruptions are merely symptoms. Resolving the problems of energy production and consumption issues requires that short-term remedies be undertaken, but in addition, long-term and fundamental investigations are necessary to develop alternative options for society many decades into the future. (MCW)

12395 ENERGY POLICY INTERACTIONS IN THE UNITED STATES. Smernoff, B. J. (Hudson Inst., Inc., NY). Energy Policy; 1: No. 2, 136-153(Sep 1973).

The U. S. policies in the economic, national security, research and development, and environmental areas were formulated prior to the 1973 energy crisis. The establishment of an energy policy that is consistent with other existing national policies will be difficult, when the inconsistencies already existing are considered. Heavily funded breeder reactor development exemplifies the type of inconsistency existing. It is suggested that a reasonable energy policy involves nuclear fission playing a minor role, clean-burning fossil fuels decreasing in importance, and geothermal or solar energy sources becoming dominant. (68 references) (MCW)

12396 ELECTRICAL TRANSMISSION OF ENERGY: CURRENT TRENDS. Howard, P. R. (Central Electricity Generating Board, Guilford, Eng.). Energy Policy; 1: No. 2, 154-160(Sep 1973).

The trend towards ultrahigh voltages in the 1000 to 1500 kV range involves new technological and environmental problems. Technically, there is no difficulty in constructing lines and substations at voltages up to 1500 kV or higher, but the economic, environmental, and aesthetic parameters must be considered. Underground cables cost 20 times more than overhead lines. Existing electrical transmission systems and future systems necessary are discussed for the UK, the European countries, and North America. (MCW)

12397 BEAUTY AND THE BEAST: THE SITING DILEMMA IN NEW YORK STATE. Kaufman, A. (State of New York Public Service Commission, Albany). Energy Policy; 1: No. 3, 243-253 (Dec 1973).

An analysis of the problems encountered in the siting of large power plants is presented for the state of New York. Opposing factions are the great demands for electrical energy and the desire for an unpolluted and pleasing environment. The slowing down of power plant commissioning has resulted in continued use of obsolete stations and the overuse of gas turbines, leading to inefficient electricity generation. Calculations show that the impact on the consumer of the plant siting problem in 1972 was $117 million, assuming one hour of load shedding for 5% of the state. Whether the residents have obtained benefits of more than $117 million in improved environment is problematical considering the old and the inefficient machines used to meet demand. (MCW)

12398 ENERGY IN THE USA AFTER THE PRESIDENT'S MESSAGES: LIKELY EFFECTS ON SUPPLY AND DEMAND. McDonald, S. L. (Univ. of Texas, Austin). Energy Policy; 1: No. 3, 179-186(Dec 1973).

When the President's proposals to deal with the energy crisis in the USA are classified according to the time that must elapse before they yield significant results, a logical pattern emerges. In the short run (less than three years) there is little that can be done to increase supplies of domestically produced oil and gas, the two most critical energy sources. So to avoid rationing or sharply rising prices it is necessary to yield some ground in respect to national security and environmental protection: to free oil imports of quantitative restrictions and delay further restraint of high-sulphur coal consumption so as to increase the supply of oil and decrease the demand for gas and fuel oil. In the intermediate run (three to six years) it is possible to do something about oil and gas supplies from domestic sources. They can be significantly increased in this period by accelerating the leasing of areas in the outer continental shelf, constructing the Alaskan pipeline, and granting tax credit incentives to exploration. At the same time the deficient supply of gas can be remedied by allowing the price to rise to the market-clearing level, and the demand for oil and gas can be reduced by conserving energy at the consumer level and speeding up the development of geothermal and nuclear power. It is possible that as a result of these measures the share of imports in total oil consumption will stabilize (although the construction of deepwater ports to handle super tankers will tend to make imports more competitive) and the reduction of high-sulfur coal consumption necessary to protect the environment can be afforded. In the long run (six years and more) an immediate increase in public spending on energy R & D and early implementation of a large-scale pilot program in shale oil development may be expected to yield additional supplies of oil from shale, additional supplies of gas from coal, and restrained demand for oil and gas as the result of new techniques in nuclear power (fast breeder reactor) and new means of protecting the environment from the effects of mining and burning high-sulfur coal. (auth)

12399 IMPACT OF THE MOTOR CAR ON OIL RESERVES. Leach, G. (Univ. of Sussex, Brighton, Eng.). Energy Policy; 1: No. 3, 195-207(Dec 1973).

Road vehicles, and particularly the car, consume substantial shares of the world's oil resources, though they do not account for a very significant proportion of total energy consumption. In 1970 the world car fleet took 12% of global oil consumption or 6% of gross energy consumption. Other road vehicles took nearly the same again: 9% of world oil and 4.5% of total energy. The USA car fleet, with 48% of the vehicles, accounted for 65% of the oil consumption of the world car fleet. Forecasts indicate a large world car population growth. The question is studied of how governments and communities will act in this situation. If they continue to permit the private motorist unfettered freedom to own cars with extravagant fuel consumption, the growing demands of motoring are certain to accelerate the exploitation of the world's dwindling oil reserves and raise prices. It will merely postpone the problem of depleting oil supplies. Alternatives are discussed and include encouragement of public transport systems, smaller cars, development of batteries and conversion of organic wastes, and rails and waterways for freight transport. (MCW)

12400 FUTURE GROWTH OF NUCLEAR POWER. Part 2. Choices and Obstacles. Surrey, A. J. (Univ. of Sussex, Brighton, Eng.). Energy Policy; 1: No. 3, 208-224(Dec 1973).

Choices and obstacles in the future development of nuclear power technology are discussed, with examination of technical options, public safety, and economics. A major difficulty is to establish a realistic basis for comparison, for nuclear plants are relatively capital-intensive while fossil-fuel plants are fuel-intensive. Once built, a nuclear plant is normally utilized to the maximum, because its running costs are only a fraction of those of even the most efficient fossil-fuel plant. The basic sources of uncertainty are safety and future technical progress and it is these aspects that will jointly determine the long-term acceptability and competitiveness of nuclear power. (42 references) (MCW)

12401 SURVEY OF THE MARKET FOR NUCLEAR POWER IN DEVELOPING COUNTRIES. Falls, O. B. (International Atomic Energy Agency, Vienna). Energy Policy; 1: No. 3, 225-242(Dec 1973).

The long-range economic justification for nuclear power plants in 14 of the developing countries was studied and analyzed from a survey in 1972-1973 by the IAEA. Some computer programs were developed for the survey. Concluding facts on the market survey show that, during the period 1980–1989, there is essentially no market for small nuclear power units of sizes 300 MW and smaller. There is a substantial market for 600 MW and 800- to 1000-MW sizes. The total thermal power plant market for the nuclear portion is less than 50% up to 1982; 70 to 75% in 1982-1984; 80 to 95% in 1985 to 1989. Once nuclear plants are indicated for a given country, they will continue so in the future. After the larger sizes (600 MW and over) become justified, substantial changes in the values of the economic parameters (oil prices or discount rates) will have little effect on the total nuclear plant market since essentially all units will prove to be nuclear from that point into the future. (MCW)

Information Handling

12402 (ORNL-4929) OAK RIDGE COMPUTERIZED HIERARCHICAL INFORMATION SYSTEM (ORCHIS) STATUS REPORT, JULY 1973. Brooks, A. A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1974. Contract W-7405-eng-26. 63p. Dep. NTIS $5.45.

This report summarizes the concepts, software, and contents of the Oak Ridge Computerized Hierarchical Information System. This data analysis and text processing system was developed as an integrated, comprehensive information processing capability to meet the needs of an on-going multidisciplinary research and development organization. (auth)

12403 ENDS: EUROPEAN NUCLEAR DOCUMENTATION SERVICE. Vernimb, C. O.; Steven, G. (Centre for Information and Documentation, Luxemburg). Nucl. Eng. Des.; 25: No. 3, 325-333(1973).

The mechanized European Nuclear Documentation Service which provides both retrospective searches and selective dissemination of information (SDI) to its users, at present covers 1.3 million documents. A description is given of the structure and the main features of the system including selection of literature, input operations, file organization, and search procedures. Special features of the system are indexing of abstracts by assignment of descriptors from a thesaurus, the use of an on-line dialog for retrieval, and the application of an advanced relevance feedback procedure. (auth)

Law

12404 QUALITY ASSURANCE: TRANSLATING DOCTRINE INTO ACTION. Ramey, J. T. (Atomic Energy Commission, Washington, DC). At. Energy Law J.; 15: No. 1, 3-20(Spr 1973).

The progress and problems associated with translating quality assurance policies into concrete actions for nuclear power plants, specifically, are discussed. Reliability and a forecast for nuclear power growth are examined. With continuing emphasis on quality assurance and engineering standards, the AEC is encouraging and supporting activities leading to greater standardization of nuclear power plants. These key policies and approaches are discussed with respect to translation into action and demand public acceptance after sufficient experience demonstrates that nuclear power plants can be built and operated in a safe, reliable, and economic manner in an environmentally acceptable manner. (MCW)

12405 STANDARDIZATION IN NUCLEAR POWER. Muntzing, L. M. (Atomic Energy Commission, Washington, DC). At. Energy Law J.; 15: No. 1, 21-33(Spr 1973).

Forecasts for increases in electric generating capacity by nuclear power through the year 2000 are discussed. The practice of having wide design variations among individual nuclear power plants needs to be arrested. Variability is desirable and normal in early developmental stages, but the time has come for standardization. The US AEC strongly endorses the concept of standardization. Custom plants will be reviewed, but standardized plants will receive priority in scheduling. The expected benefits of standardized plants include enhanced safety, shortened lead times, and reduced costs. The potential disadvantages that are mentioned include stifled innovation, difficulty for new companies to enter the nuclear field, and there may be less need under standardization procedures for utility staffs and technical managements to be intimately involved in the detailed technical review of plant designs at the construction permit stage, (MCW)

12406 PROPER ROLE OF THE PUBLIC IN NUCLEAR POWER PLANT LICENSING DECISIONS. Muchnicki, E. D. (George Washington Univ., Washington, DC). At. Energy Law J.; 15: No. 1, 34-59(Spr 1973).

An attempt of the AEC to deal with the problem of public participation in the licensing of nuclear power plants is examined. The primary goal of AEC's nuclear power plant program is to provide cheap, clean electric power. The AEC is both promoter and regulator of a vague congressional mandate encouraging public participation. In the atomic energy program, highly technical scientific information is applied to achieve social policy goals. Atomic energy technology was initiated and actively guided through its development by the federal government rather than through private enterprise. Nuclear power offers an important, immediate benefit that must be balanced against hypothetical remote possibilities of harm that could be catastropic. The problems involved when public intervention occurs are discussed, but the AEC has recognized the need for public participation in its licensing process and has taken steps to accommodate the political need for public participation with the administrative need for timely decisions. (MCW)

12407 NEW X-RAY REGULATION. March 1, 1973 Regulation on Protection Against Radiation Injuries. Kossel, F.; Washsmann, F. (Abteilung fuer Strahlenhygiene, Munich). Fortschr. Med.; 91: No. 17, 723-724(14 Jun 1973). (In German).

The First Radiation Protection Regulation for West Germany related only to radioactive material. The present Regulation, relating to x rays, was passed in December 1972; after a transition period of six months, it will become effective on September 1, 1973. Listed and discussed are the most important sections of the regulation that concern licensing of x-ray installations, professional expertise of operators, operation of installations for therapy, controlled and monitored areas, licensure to administer x radiation to patients, and the keeping of appropriate records. Also presented are professional radiation exposures with maximal doses, personnel dosimetry, and radiation hazards as well as protective measures. (HBG)

Management

Refer also to abstract 11756.

12408 (CEA-CONF-2349) NUCLEAR QUALITY. Prot, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Surete Nucleaire). 1973. 10p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

After a review of the origins of the problems of nuclear quality, the means developed in order to attain this quality with respect to legislation, organization, fabrication, qualification of personnel, specifications, and environment are reported. Two examples are given which illustrate the progress which still needs to be made in the particular region of the control of the quality of nuclear equipment. (tr-auth)

12409 (DEU-72-12) BUSINESS REPORT OF THE 49th FISCAL YEAR 1970. (Kraftanlagen A.G., Heidelberg (F. R. Germany)). 1971. 39p. INIS.

An account is given by the board of directors of the general economic situation (orders, shares, investment etc.) and the establishment of a "nuclear technological service" for the German nuclear power plants (radiation protection, decontamination, repair, fuel recharging). An account of the activities of the supervisory board and the balance sheet is also given. (GE)

12410 (DEU-72-13) BUSINESS REPORT OF THE 50th FISCAL YEAR 1971. (Kraftanlagen A.G., Heidelberg (F. R. Germany)). 1972. 39p. (In German). INIS.

An account is given by the board of directors of the economic development and indication of the expansion of the activities of the "nuclear technological service". An account of the supervisory board and the balance sheet with explanatory remarks is added. (GE)

Mathematics and Computers

Refer also to abstract 10573.

12411 (AEEW-R-876) APPLICATION OF A DESIGN COMPUTER CODE TO DETERMINE THE OFF-DESIGN CHARACTERISTICS OF THE GIBRALTAR VERTICAL TUBE EVAPORATOR DESALINATION PLANT. Guneratne, D. C. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Mar 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

A technique has been developed to use the computer program MULTEFFECT to assess the performance of an evaporator desalination plant under conditions other than those for which it was designed. As an example of the method, a detailed study of the predicted behavior of the Gibraltar VTE plant was made for a variety of off-design conditions. This report discusses the philosophy underlying the technique, and presents the results obtained for the Gibraltar study. (auth)

12412 (COO-1469-220) EFFECT OF VARIABLE MESH SIZE ON THE STABILITY OF MULTISTEP METHODS. Gear, C. W.; Tu, K. W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Apr 1973. Contract AT(11-1)-1469. 35p. (UIUCDCS-R-73-570). Dep. NTIS $3.75.

The effects of two different techniques for implementing variable mesh sizes in multistep formulas are investigated. It is proved that one is more stable than the other for some cases, but that both are stable when the step changes are small. The practical implications of these results are discussed. (auth)

12413 (COO-1469-221) STABILITY AND CONVERGENCE OF VARIABLE-ORDER MULTISTEP METHODS. Gear, C. W.; Watanabe, D. S. (Illinois Univ., Urbana (USA). Dept. of Computer Science). May 1973. Contract AT(11-1)-1469. 28p. (UIUCDCS-R-73-571). Dep. NTIS $3.50.

The variable-step Adam's method is shown to be stable for any order-changing scheme. The Nordsieck form of Adam's method, however, is shown to be stable only if the step size and order are fixed for p steps following a change to an r-step method, where p is r or r + 1 depending on the algorithm used to interpolate the necessary higher derivatives. Finally, general consistent and strongly stable multistep and multivalue methods are shown to be stable if the method is fixed for a certain number of steps following each method change and step size changes are small. This number is independent of the differential equation and the step sizes. (auth)

12414 (COO-1469-224) QUARTERLY TECHNICAL PROGRESS REPORT, JANUARY – MARCH 1973. (Illinois Univ., Urbana (USA). Dept. of Computer Science). 1973. 217p. (COO-2118-45; UIUCDCS-QPR-73-1). Dep. NTIS $13.00.

Significant information is reported on the following: circuit research; hardware systems research; software systems research; image processing and pattern recognition research: ILLIAC III; computer languages for mathematics and numerical analysis; machine and software organization; MESH research project; and automation of introductory computer science courses. The Center for Advanced Computation reports primarily on development and testing of numerical techniques and software systems for use of ILLIAC IV over the ARPA network. Documents and publications for the period are listed. (LMT)

12415 (COO-1469-234) DESIGN OF A HIGH-NOISE IMMUNITY ANALOG FREQUENCY COUNTER. Loessel, M. C. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1973. Contract AT(11-1)-1469. 40p. (UIUCDCS-R-73-595). Dep. NTIS $4.00.

Thesis.

The design of a unique analog frequency counter is described. Frequency response is not as high as some counters currently on the market, being only 0 to 100 kHz. However, the technique used to convert analog input frequency to digital pulses provides more immunity to false triggering than any popular counter of today. The low-cost counter uses state-of-the-art components. (auth)

12416 (COO-3288-27) STUDIES IN THE ORGANIZATION OF COMPUTER SYSTEMS. Progress Report No. 27, October 1, 1972 – September 30, 1973. Flynn, M. J. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1973. Contract AT(11-1)-3288. 10p. Dep. NTIS $3.00.

The research program continued its activity in the study of parallel processors and the representation of programs for such processors. In addition, a study was completed on microprogram structures, and the design of a small microprogrammed processor suitable for the research was initiated. (auth)

12417 (GEAP-10546) PART I. Theory Report for CREEP-PLAST Computer Program: Analysis of Two-Dimensional Problems Under Simultaneous Creep and Plasticity. Rashid, Y. R. (General Electric Co., San Jose, Calif. (USA). Nuclear Fuels Dept.). Jan 1972. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Solution of the combined creep and plasticity problem is considered. Both creep theories, the equation-of-state and memory theories, are used within the framework of the finite-element computational method. Because of the limited creep data, which is available only for single-step simple extension experiments, the integral expansion in the memory theory formulation is limited to one nonlinear superposition integral. However, instead of using

direct superposition as proposed earlier, the kernel function was derived as an integral transformation that reduced the time–temperature–stress relationship to a single quantity. The equation-of-state formulation is based on the monotonic strain-hardening rule applied to the primary creep component only. The uniaxial stress–strain law is first discussed with emphasis on the memory theory. Then the incremental stress–strain relations for the combined creep and plasticity problem are derived for both creep theories. The time–temperature–stress transformation is derived for a particular class of material that exhibits well-defined primary and secondary creep parts such as stainless steel. The properties of the resulting stress–strain integral are discussed in relation to the direct-superposition method. Finally, example analyses are given. (auth)

12418 (GEAP-13262) PART II. User's Manual for CREEP-PLAST Computer Program. Rashid, Y. R. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Mar 1972. Contract W-7405-eng-26. 50p. Dep. NTIS $4.50.

This report describes the input procedure of the computer program CREEP-PLAST developed for metal structures under high temperatures. The program is written in FORTRAN and is operational on the IBM-360 system and the UNIVAC 1108 computer. It applies to plane and axisymmetric structures and has a capacity of 900 nodal points, 1800 elements and 200 time steps. The program follows an incremental procedure in time and requires the user to specify his own time steps. Instantaneous load changes can be introduced by repeating the time point at which the step change in loading occurs. This allows the user to introduce an instantaneous elastic-plastic phase anywhere in the time history. For an elastic–plastic analysis, only zero time array must be specified. The program has the capability to iterate on the solution within each time step thus permitting the user to specify larger time steps or to improve upon the accuracy of the calculations. Generally one iteration is all that is required. Creep and plasticity are assumed to occur simultaneously. The plasticity formulation is based on kinematic hardening and von Mises yield condition, and makes use of the Tangent Stiffness approach. The creep formulation, however, is based on two alternate approaches: the usual equation-of-state theory, with primary strain hardening, and the memory-theory approach based on a modified superposition principle. The user has the option to select either one of these two creep formulations in addition to plasticity. (auth)

12419 (HEDL-SA-563) IMPLEMENTATION EXPERIENCES OF NASTRAN ON CDC CYBER 74 SCOPE 3.4 OPERATING SYSTEM. Go, J. C. D.; Hill, R. G. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. 5p. (CONF-730959-1). Dep. NTIS $3.00.

From third NASTRAN colloquium; Hampton, Virginia, USA (11 Sep 1973).

The experiences of the implementation of the NASTRAN system on the CDC CYBER 74 SCOPE 3.4 Operating System are described. This Operating System is relatively new, but with the flexibility of the NASTRAN system, no problems were encountered. Only minor changes were made. Various sizes of benchmark and test problems, ranging from two hours to less than one minute CP time were run on CDC CYBER SCOPE 3.3, UNIVAC EXEC-8, and CDC CYBER SCOPE 3.4. No numerical discrepancy was found on the outputs of these test problems. (auth)

12420 (KAPL-M-7313) DATATRAN 2 PRIMER. Kopp, H. J. (Knolls Atomic Power Lab., Schenectady, N. Y. (USA)). Aug 1973. Contract W-31-109-eng-52. 46p. Dep. NTIS $4.50.

DATATRAN 2 is a data base management language that is used as the environment for a modular computer program network. This manual serves as an introduction for input preparation for nonprogrammers and module construction for FORTRAN programmers. (auth)

12421 (KFK-PDV-9) HARDWARE EXTENDED EXECUTIVE PRIMITIVES FOR PROCESS CONTROL SYSTEMS. 2. Intermediate Report: Executive Primitives for Working Space Management. Rupp, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Datenverarbeitung in der Technik). Jul 1973. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

Three alternative realizations of executive primitives for the nucleus internal working space management are reviewed and discussed. (auth)

12422 (LA-5430-MS) NOVA BRANCH-DRIVER OPERATION. Biswell, L. R.; Van Buren, D. T. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

The Branch Driver (BD) is the interface between a Nova or Supernova computer I/O and a multicrate CAMAC system. The manual discusses the operation and design specification of the BD and has a description of the instructions used. The complete set of non-CAMAC instructions for the BD is given. Programming examples for several types of modules and standard function codes for CAMAC are presented. A complete set of schematics is available, but is not included. (auth)

12423 (ORO-4061-10) INTERCHANGE OF ESSENTIAL PROGRAMS BETWEEN DISSIMILAR COMPUTERS. Final Report. Feustel, E. A. (Rice Univ., Houston, Tex. (USA). Lab. for Computer Science and Engineering). 27 Jun 1973. Contract AT(40-1)-4061. 9p. Dep. NTIS $3.00.

The object of the research is to show how essential programs such as components of operating systems may be transferred from one computer to another in the simplest manner. The research is summarized for the period September 1969 to June 1973. (MOW)

12424 (RL-73-126) MNEMONIC: AN INTERACTIVE GRAPHICS PROGRAM TO GENERATE A TRIANGULAR MESH FOR TRIM. Newman, M. J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1972. 21p. (RHEL/R-238). Dep. NTIS (U.S. Sales Only) $3.25.

Lack of any easily available graphical display has been a severe limitation in the use of TRIM, the two-dimensional magnetostatic program in batch use at the Rutherford Laboratory. Data preparation for TRIM for any nontrivial geometry is a lengthy task. There are many possibilities for errors. Interpretation of error diagnostics without graphics facilities is a tedious and inefficient process. Using batch processing, many days can be spent in removing errors from a complex set of data. MNEMONIC allows TRIM users to test their boundary data using a graphics display terminal. It allows them to correct any errors interactively, and to generate a triangular mesh as required by TRIM. The resultant mesh can also be inspected and edited if necessary. The mesh data and a full set of data for TRIM can be stored on disk datasets for subsequent access by TRIM in the batch. Thus a corrected set of data can be created in one short on-line session. The users can also avoid time wasting and expensive calculations with data that contains errors which TRIM has not detected. (auth)

12425 (SLA-73-859) RESULTS OF CDC 6600 AND DEC PDP10 FORTRAN LIBRARY FUNCTIONS FOR INVALID ARGUMENTS. Bailey, C. B.; Herrera, T. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 112p. Dep. NTIS $7.75.

The diagnostics, error modes, and function values that result when FORTRAN library functions are referenced with infinite, indefinite, or out-of-range arguments on the CDC 6600 or the DEC PDP10 are reported and discussed. (auth)

12426 (SLA-73-926) INPUT PROCESSOR FOR TONOPAH TEST RANGE COMPUTER CENTER. Minnear, L. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 48p. Dep. NTIS $4.50.

The input processor collects all digital data from nine radars and from the IRIG digital time base and stores it in the central memory of the DDP-124 computer within 100 μsec. A modular concept of design and fabrication simplified construction and will facilitate future expansion. (auth)

12427 (SLA-73-990) AUTOCORRELATION FUNCTION OF THE OUTPUT OF A HARD LIMITER WITH GAUSSIAN NOISE PLUS SINUSOIDAL INPUT. Aronson, E. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 24p. Dep. NTIS $3.25.

An expression is derived for the autocorrelation function of the output of a hard limiter whose input is stationary gaussian noise with zero mean plus independent random-phase sinusoidal signal. The output spectrum may then be evaluated. This spectrum is extremely useful in understanding the properties of a filter–limit–filter–detect signal processor whose signal input is an actual sinusoid or when a sinusoid is used as a test signal. Some numerical values of the autocorrelation function are also given. (18 references) (auth)

12428 (SLA-73-6004) THEORY OF RANDOM GRAPHS. Kovalenko, I. N. Translated by P. Newman from Kibernetika; No. 4, 1-4(1971). 10p. Dep. NTIS $3.00.

There have been several studies of the probability of joining and other characteristics of the structure of a random graph with an infinitely increasing number of nodes. V. E. Stepanov developed an analytical theory for calculating the probability of joining a random graph under the assumption that the ith node is joined to the jth node with a probability $1 - e^{-\lambda_i \lambda_j t}$. (The evolution of a random graph consisting of the random appearance of new nodes is discussed.) The present article considers the problem under the assumption that the probability of a joining between the ith

and jth nodes of the graph is equal to $p_{ij} = p_{ij}$ (n); the set (p_{ij}) is required to fulfill a given integral relationship and to have uniform smallness p_{ij}. (tr-auth)

12429 (SLL-73-270) OPERATION AND MAINTENANCE DOCUMENT FOR PROGRAM SHKSPEC. Holbrook, E. D. (Sandia Labs., Livermore, Calif. (USA)). Nov 1973. Contract AT(29-1)-789. 68p. Dep. NTIS $5.50.

Program SHKSPEC is one of a series of programs in the Sandia Laboratories, Livermore, Data Reduction Library. It is written in FORTRAN for the CDC 6600 computer. Its purpose is to determine the shock spectrum for a given time history input (g versus time) from a standard Master Disc File. The program does not attempt to perform the entire family of shock spectra, but it realizes a popular subset that satisfies the existing needs of Data Processing Division 8443. (auth)

12430 (UCID-16381) LLL COMPUTER GRAPHICS OUTPUT DEVICES. Vickers, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1973. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

The purpose of the included chart is to let a user quickly see what is available in computer graphics output devices and thereby to aid him in choosing the most appropriate method for putting out computer-contained information in graphic form. Listed on the chart are the most commonly used graphic output devices with those used more frequently appearing higher on the list. At the bottom are devices which are anticipated in the near future. In addition to providing technical information, the chart also includes information about available literature and use of the devices. (MOW)

12431 (UCID-30076) SIMULATION OF A MODEL OF A CDC 7600 COMPUTER. Sutherland, G. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1973. Contract W-7405-eng-48. 23p. Dep. NTIS $3.25.

A program to simulate the performance of a model of the CDC 7600 at the Lawrence Livermore Laboratory is described. The method of programming, model input, verification of the model, and some simulation experiments are shown. (auth)

12432 (USRL-51420(Rev. 1)) SOLUTIONS OF THE SCALAR HELMHOLTZ EQUATION IN THE ELLIPTIC CYLINDER COORDINATE SYSTEM. Lytle, R. J.; Lager, D. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1973. Contract W-7405-eng-48. 22p. Dep. NTIS $4.00.

A method for determining the eigenvalues for the scalar Helmholtz equation in the elliptic cylinder coordinate system is described. Complex expansion parameters are considered so that numerical results for physical problems involving energy dissipation as well as energy flow can be obtained. Sample numerical results are presented for the eigenvalues, radial eigenfunctions, and angle eigenfunctions. Applications of these results are discussed. (auth)

12433 (UCRL-51472) MODIFIED LU DECOMPOSITION ALGORITHM FOR A SYMMETRIC, TRIDIAGONAL MATRIX. Chin, R. C. Y. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Oct 1973. Contract S-7405-Eng-48. 6p. Dep. NTIS $4.00.

A modified factorization algorithm for the solution of a linear system with a symmetric tridiagonal coefficient matrix is presented. The asymptotic behavior of the factored matrix coefficients is incorporated into the algorithm to yield additional computational efficiency. (auth)

12434 (UCRL-75004) NUMERICAL IMAGE RESTORATION BY THE METHOD OF SINGULAR-VALUE DECOMPOSITION. Ekstrom, M. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 31 Oct 1973. 5p. (CONF-740101-1). Dep. NTIS $3.00.

From seventh international conference on system sciences; Honolulu, Hawaii, USA (8 Jan 1974).

The numerical image restoration problem is considered for the case of shift-variant imaging. The solution formalism presented is based on the method of singular-value decomposition. Some special-case versions of the formalism are considered. (auth)

12435 (WAPD-TM-1137) BH99: A PROGRAM FOR THE STATISTICAL ANALYSIS OF DATA BASED ON THE EXTREME-VALUE DISTRIBUTION. Shimamoto, T. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). Aug 1973. Contract AT(36-1)-GEN-14. 19p. Dep. NTIS $3.00.

BH99 is a program for use in the statistical analysis of data based on the extreme-value distribution $F(x) = \exp(-e^{-(x-\mu)/\beta})$. The constants required to fit this distribution using order statistics for samples of sizes up to n = 35 were computed. (auth)

Miscellaneous

12436 (BARC-683) PILOT PLANT STUDIES ON THE PRODUCTION OF DUCTILE TITANIUM SPONGE FROM PURE TITANIUM TETRACHLORIDE. Ahluwalia, H. S.; Kulkarni, A. P.; Vijay, P. L.; Subramanian, C.; Swaminathan, K.; Rajagopalan, P. K.; Rao, Ch. S.; Sundaram, C. V. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

Three different routes were examined, namely: (i) magnesium reduction and pyro-vacuum treatment, (ii) magnesium reduction and acid leaching, and (iii) two-stage reduction with sodium, followed by aqueous processing. Magnesium-reduced and vacuum-treated titanium sponge was of uniformly good quality, contained less than 1000 ppm oxygen, and corresponded to a button hardness of 90 to 100 VPN. Acid-leached sponge from magnesium reduction had a relatively higher oxygen content (1000 to 1500 ppm), but was still of acceptable quality (hardness 125 VPN). A significant portion of the metal from sodium reduction was in the form of shiny crystals, of very low button hardness (60 to 90 VPN). The operations established the satisfactory performance of the various equipment designs and also the optimum process conditions. (auth)

12437 (BARC-704) TOLERANCES IN LABORATORY GLASS-BLOWING. Bhide, G. K. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

Need for establishing widely accepted, normal standard tolerances on various angular and linear dimensions of blown glass apparatus fabricated according to designs, is discussed. A scheme of standard tolerances is suggested for typical glass-working jobs involving bends, other blown shapes, joints, etc. General criteria of "quality" and "finesse" of glass-blown jobs are highlighted vis-a-vis those of other mechanical workshop jobs. (auth)

12438 (BDX-613-926(Rev.)) VIBRATION ANALYSIS. Berry, C. W. Jr. (Bendix Corp., Kansas City, Mo (USA)). Dec 1973. Contract AT(29-1)-613. 42p. Dep. NTIS $4.25.

Information necessary for the design of vibration isolation systems is presented. Measurement of vibration levels and equipment vibration fragility are discussed along with methods and materials for vibration isolation. An Isolation Test Table having a natural frequency that is tunable from 0.5 to 20 Hz has been developed. (auth)

12439 (CEA-CONF-2196) TRANSFER OF COLLISIONAL EXCITATION IN THE NEUTRAL VAPOR OF CESIUM. Pimbert, M.; Rocchiccioli, J. L. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 12 Apr 1972. 6p. (In French). (CONF-720552-3). Dep. NTIS (U.S. Sales Only) $3.00.

From sixth conference on collisions of atoms and electrons; Liege, Belgium (17 May 1972).

Data for Cs were reported earlier. In the present study the transitions from the $8\ ^2P_{\frac{1}{2}}$ level induced by collisions with molecules of nitrogen and hydrogen were measured and the results were compared with those obtained in the presence of some rare gases. An upper limit of the quenching cross sections was obtained for He, Ne, Ar, Kr, and Xe and an approximate value was obtained for H_2 and N_2. There is sharp disagreement between the measured values and the theoretical values. The reasons for this disagreement are discussed. (JSR)

12440 (CEA-CONF-2370) MOBILITY OF MACROPHAGES AND ALVEOLAR DECONTAMINATION IN DIFFERENT KINDS OF ANIMALS. Nolibe, D.; Metivier, H.; Masse, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). [nd]. 2p. (In French). (CONF-730570-2). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on alveolar macrophage; Lille, France (28 May 1973).

The mobility of macrophages in relation to alveolar decontamination following the inhalation of toxic substances was studied in the dog, monkey, cat, rat, and guinea pig. The alveolar macrophages showed a migration rate that varied from 30 to 10% in the rat and rabbit. The measurement of alveolar decontamination should take into consideration inter-species differences in macrophage mobility. (JSR)

12441 (CEA-CONF-2373) VALORIZATION OF MOS TECHNOLOGIES BY THE USE OF IONIC IMPLANTATION. Bernard, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique). 15 Feb 1973. 22p. (In French). (CONF-730132-1). Dep. NTIS (U. S. Sales Only) $3.25.

From meeting on SEE studies on recent progress in MOS technology; Malakoff, France (24 Jan 1973).

After a discussion of some basic advantages of ionic implantation, the possibilities of the application of this technique in the area of MOS technology are discussed. The methods that permit alleviation of different limitations of the classical MOS technology are described. The applications foreseen with ionic implantation are summarized. Examples of technology are presented, defining the possibilities of ionic implantation both at the level of the structure of the integrated circuits developed and of the performances attained. (JSR)

12442 (CEA-R-4541) HIERARCHIZATION METHOD FOR THE ELEMENTS OF A SYSTEM. An Attempt at Forecasting Nuclear Energy System With Its "Societal" Context. Duperrin, J. C.; Godet, M. (CEA, 75-Paris (France). Dept. des Programmes). Dec 1973. 68p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Social systems are more and more complex and diversified and real phenomena are more and more interdependent; therefore, the control of the future implies an immediate knowledge of what is going to happen. The methodological approach suggested in order to foresee this future is part of the general framework of systems analysis. The general problem to which the method can be applied is to determine to what extent certain factors could inflect, in either way, the development curves expected by the end of the century and that are related to certain social, economic and ecological phenomena. The first part is concerned with detecting the "significant" factors and taking into account in the matrix form the interactions between these factors. A primary processing program called 'MIC-MAC" enables selection of major factors in terms of "fall-out" over the studied system. The hierarchical criterion taken into consideration is that of the number of feedbacks of even factor. In order to make use of the matrix of influence reduced to the major factors, the partial graphs resulting from the variables kept as the targets of the study are considered. The program "MICROBE" allows the use of positive and negative feedbacks, i.e., the multiplying and the reducing effects of development which are the fundamental bases of the elaboration of the "scenarii". In the second part, the methodology is illustrated by the actual case of the nuclear energy system. Two "scenarii" are presented, that of the forecaster and that of the planner. (auth)

12443 (CISE-N-159) DESIGN AND CONSTRUCTION OF A CO_2 LASER WITH SUBATMOSPHERIC PRESSURE IN FLUX. Sironi, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Jun 1973. 23p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.25.

The design data of the laser source are reported. The discharge and emission parameters were calculated for continuous and pulsed operation. The use of the source for etching of ceramics is described, and the design is given for a modulator external to the cavity. (JSR)

12444 (COO-623-194) SPIN-WAVE SPECTRUM OF AN AMORPHOUS FERROMAGNET. Gubernatis, J. E.; Taylor, P. L. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Dept. of Physics; Washington Univ., Seattle (USA). Dept. of Physics). 1973. 27p. Dep. NTIS $3.50.

The spin-wave spectrum of an amorphous Heisenberg ferromagnet is calculated by a diagrammatic expansion making use of a transformation due to Taylor and Wu Phys. Rev., B2: 1752 (1970). The upper limit of the spectrum is found to occur at frequencies below that of the corresponding crystalline system, while the low-frequency part of the spectrum is enhanced. Internal van Hove singularities are absent in the spin-wave spectrum of the amorphous ferromagnet. (auth)

12445 (COO-623-196) LOW-FREQUENCY DIELECTRIC CONSTANT OF VITREOUS ARSENIC TRISULFIDE. Fontanella, J.; Andeen, C.; Schuele, D. (United States Naval Academy, Annapolis, Md.; Case Western Reserve Univ., Cleveland, Ohio (USA)). 1973. 6p. Dep. NTIS $3.00.

The 1000-Hz, 300°K dielectric constant of two samples of Servofrax arsenic trisulfide glass was determined to be 7.9093 and 7.9097. (DLC)

12446 (COO-623-197) EFFECT OF OH^- ON THE LOW-FREQUENCY DIELECTRIC CONSTANT OF VITREOUS SILICA. Andeen, C.; Schuele, D.; Fontanella, J. (Case Western Reserve Univ., Cleveland, Ohio (USA); United States Naval Academy, Annapolis, Md.). 1973. 20p. Dep. NTIS $3.00.

It is found that $\epsilon_s = 3.8073 + 2.72 \times 10^{-22}$ N, where N is the hydroxyl concentration in ions/cm^3. (DLC)

12447 (COO-623-201) SOLID STATE PHYSICS PROGRAM. Annual Progress Report. (Case Western Reserve Univ., Cleveland, Ohio (USA)). Nov 1973. Contract AT(11-1)-623. 24p. Dep. NTIS $13.25.

The present status of seven problems in thin films and surface physics, six in cohesive and dielectric properties, and two in solid state theory is described. The magnetoresistance of a metal having a spherical Fermi surface, but cubic symmetry for the electron scattering, was calculated by the magnetic-scattering eigenfunction approach. A method was developed for determining accurately the orientation of single crystals from Lane photographs. (auth)

12448 (COO-1469-235) PENETRON LAND COLOR DISPLAY SYSTEM (PENTECOST) AND SOME OBSERVATIONS CONCERNING COLOR PERCEPTION. Panigrahi, G. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Oct 1973. Contract AT(11-1)-1469. 151p. (UIUCDCS-R-73-583). Dep. NTIS $9.75.

Thesis.

This work examines the human color vision mechanism in light of Dr. E. H. Land's two-color experiments on color vision. The problem of color perception in machines is looked into. Some of the two-color experiments are described. But the main emphasis has been on the building of a two-color television display system based on the two-color projection experiments. The Penetron Electronic Color System (PENTECOST) is a two-primary color television system intended to examine the scope and the limitations of using the Land two-primary scheme for high resolution color information displays. It employs a penetration type cathode ray tube (Penetron) having red and white layers of phosphors that are sequentially excited every alternate field to display the red and green record of a scene taken synchronously through the red-green color filter-wheel. The Penetron tube as a color display tube is evaluated and the different switching and registration circuits are described. The camera system with the lead-oxide vidicon (Plumbicon) pick-up tube, the color filter-wheel, and the associated synchronizing circuits are also described. The use of an electronically controlled solid state filter like Gadolinium Molybdate instead of the color wheel is considered. (auth)

12449 (COO-2107-9) CORRELATION OF SUBSTRUCTURE WITH MECHANICAL PROPERTIES OF PLASTICALLY DEFORMED AISI 304 AND 316 STAINLESS STEEL. Progress Report, January 1-March 31, 1973. Moteff, J. (Cincinnati Univ., Ohio (USA)). 15 Jun 1973. 53p. Dep. NTIS $4.75.

The recovery behavior of cold-worked AISI 316 stainless steel was studied using hot hardness. Hot hardness and substructure of AISI 304 stainless steel were correlated with tensile data, and transmission electron microscopy was carried out. The substructure of Incoloy 800 tensile tested at 800 to 1400°F was studied. (DLC)

12450 (COO-2204-10) ACOUSTIC EMISSION AND THE PORTEVIN-Le CHATELIER EFFECT. Progress Report, November 1, 1972-November 1, 1973. Hartman, W. F. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1973. Contract AT(11-1)-2204. 6p. Dep. NTIS $3.00.

12451 (COO-2315-1) THEORY OF ELECTRON-PHONON SCATTERING EFFECTS IN METALS. Progress Report, March 1-November 30, 1973. Lawrence, W. E. (Dartmouth Coll., Hanover, N. H. (USA)). 1973. Contract AT(11-1)-2315. 8p. Dep. NTIS $3.00.

12452 (COO-3027-15) HIGH-TEMPERATURE THERMAL PROPERTIES OF LIQUID METALS, GASES, AND VAPORS. Progress Report, October 1, 1972-September 30, 1973. Bonilla, C. F. (Columbia Univ., New York (USA). Liquid Metals Research Lab.). 1 Sep 1973. Contract AT(11-1)-3027. 16p. Dep. NTIS $3.00.

12453 (COO-3150-18) EXCHANGE AND CRYSTAL FIELD PARAMETERS FROM TESR OF Al : Er. Report No. 2125. Siebert, J. F.; Dodds, S. A.; Silsbee, R. H. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Nov 1973. Contract AT(11-1)-3150. 8p. Dep. NTIS $3.00.

Transmission Electron Spin Resonance (TESR) has principally been applied to the study of the conduction spin resonance of pure metals, alloys with nonmagnetic impurities, and alloys containing magnetic impurities which show the bottleneck phenomenon. It is shown here, using the system of Al : Er (5 to 35 ppM) as an example, that the unbottlenecked TESR of the conduction electrons combined with the normal reflection ESR of the rare earth ions can yield useful information about the crystal field splittings of the rare earth f-shell, the magnitude and k-dependence of the conduction electron-rare earth ion exchange coupling, and the enhancement of the host crystal susceptibility. (auth)

12454 (COO-3151-31) STUDY OF IMPURITY MODES IN ALKALI HALIDES THROUGH LOW-TEMPERATURE SPECIFIC HEAT AND THERMAL-CONDUCTIVITY MEASUREMENTS. Peressini, P. P. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Aug 1973. 65p. Dep. NTIS $5.25.

Specific heat and thermal conductivity measurements at 0.05 to 1°K were used to study the low-lying energy levels or tunneling states of Li and OH in KCl and CN in KCl, KBr, KI, and RbCl. (auth)

12455 (COO-3476-6) MICRO-STRUCTURAL AND SOLUTE EFFECTS ON THE MEGACYCLE DAMPING OF COPPER. Banerji, S. K. (State Univ. of New York, Stony Brook (USA). Dept. of Materials Science). Oct 1973. Contract AT(11-1)-3476. 108p. Dep. NTIS $7.50.

Thesis.

Ultrasonic attenuation measurements were made in Cu–Ni alloys containing 0.01 to 10.0 at. % Ni. The microstructural effects were studied by changing the dislocation densities from 10^6 to $10^8/cm^2$. (DLC)

12456 (IPP-1-134) CONSTRUCTION, OPERATION, AND PROPERTIES OF TEA-CO_2 LASERS. Decker, G.; Kellerer, L.; Roehr, H. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F. R. Germany)). Jul 1973. 37p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Experience in building and working with TEA–CO_2 lasers is reported. Especially, the influence of electrical parameters as well as gas mixture and pressure are discussed. One chapter deals with properties of the laser beam as divergence, power distribution, and spectrum, another with problems of energy and power measurements. (auth)

12457 (IPP-4-110) ELECTRON-BEAM INITIATED hf CHEMICAL LASER. Gross, R. W. F.; Wesner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching/Munich (F.R. Germany)). Apr 1973. 45p. (In German). Dep. NTIS (U.S. Sales Only) $4.25.

For hf chemical laser initiation, an electron gun with field emission cathode was developed, which produces a large-area electron beam with an amplitude of 5.5 kA, an electron energy of 120 keV, and a half-amplitude pulse length of 25 ns. A pump rate of 4×10^{24} photons/cm^3s and a laser energy of 0.2 J/pulse were reached. The efficiency was 3.5% with reference to the electron beam energy. With a further improved electron gun, remarkable values of efficiency and yield should be reached. (auth)

12458 (IS-T-590) VISUAL EFFECTS OF SWITCHING 0.15As–0.12Ge–0.73Te GLASS. Eckels, D. E. (Ames Lab., Iowa (USA)). Dec 1973. Contract W-7405-eng-82. 32p. Dep. NTIS $3.75.

Thesis.

A voltage was applied across two point probes placed 1.4 mm apart on the virgin surface of 0.15As–0.12Ge–0.73Te glass. The applied voltage was 2 V above the threshold voltage of 150 V. After a delay time of 185 ms, the sample suddenly switched to a lower resistance. The visual effects of applying voltage to the sample were studied using 11,000 frames per second cinematography. A visual change in the surface was believed to be caused by localized melting. At a time 0.52 ms before the sample switched, a narrow apparently molten filament connected the two probes. For the visual filament to form, the filament temperature must have been greater than the glass transition temperature. For this material, the glass transition was 133°C. Thus, a filament formed and had a high temperature before the actual electrical switching occurred. Hence, switching during this experiment must have been caused by a predominantly thermal mechanism. (auth)

12459 (IS-T-615) THERMAL EXPANSION OF POTASSIUM FROM 2°K TO 320°K. Schouten, D. R. (Ames Lab., Iowa (USA)). Dec 1973. Contract W-7405-eng-82. 74p. Dep. NTIS $5.75.

Thesis.

Smoothed values of the molar volume are calculated, and the T = 0 value of the lattice constant of potassium is found to be 5.2356 ± 0.0004 Å. The thermodynamic properties are used to calculate the Gruneisen parameter. (DLC)

12460 (ITF-73-76-P) DENSITY MATRICES OF LIQUID He_4 AT LOW TEMPERATURES. Vakarchuk, I. A. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1973. 48p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

The wave functions of a system of interacting Bose-particles derived previously using the shift and collective variable method are used as a basis in calculating the density matrices. In the zero approximation, the Penrose formula for the N-particle density matrix of He_4 is obtained. The explicit expression for S-particle matrices is obtained for the first time in this approximation by integrating over the collective variables of N–S particles. The density matrices have an exponential form, and this ensures the positivity of distribution functions. The corrections to the effective-potential matrix are obtained for the ground state. The influence of these corrections on the particle momentum distribution and the pair function is investigated. The asymptotic expressions at small and large distances are obtained for the pair distribution function. (auth)

12461 (JINR-E4-7315) APPLICATION OF DIAGRAM TECHNIQUE FOR HAMILTONIANS WITH THE COULOMB INTERACTION TO HUBBARD MODEL. Westwanski, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

The realization of the general statistical Wick theorem for the Hamiltonians, containing the Coulomb interaction, is given. The diagram technique developed for some class of interactions is applied to the calculation of the transverse Green function and effective interaction within the Hubbard model. (auth)

12462 (JINR-E4-7417) ELECTRON–PHONON MASS ENHANCEMENT IN TRANSITION METALS. John, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

12463 (KFK-PDV-7) POSSIBILITIES AND LIMITATIONS OF AUTOMATIC SPEECH RECOGNITION FOR COMMAND INPUT IN CONTROL ROOMS. Quante, F. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jul 1973. 72p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

An analysis of the state of the art of automatic speech recognition shows that the recognition of about 10 commands in control rooms is feasible at an error rate of 10^{-3} and a reject rate of 10^{-1}. Forty-five recognition systems are briefly described. Improvements are not to be expected in the near future. To fulfill its task, the speech recognition system must be speaker-adaptive, and the signal tracing has to be done in the presence of acoustic noise with a noise-cancelling microphone. As a starting-point for the application in control rooms, a procedure with third-octave filtering, time, and amplitude normalization is described. (13 figures, 95 references) (auth)

12464 (KFKI-73-54) ELECTRICAL BEHAVIOR OF THIN-LAYER Au/POLYETHYLENE/Al SANDWICHES. Gazso, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). [nd]. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The electrical conduction of 1000- to 2,000-Å thick polyethylene films could be increased after electroforming processes. There was an intermediate range over which the sandwich could be switched reversibly from a lower to a higher conduction. This conduction was restricted to very localized regions and led to destruction of the system at inputs above 10^{-4} W. The breakdown resistance of the residual part was not, however, reduced. (auth)

12465 (LA-5400-MS) PUBLICATIONS OF LASL RESEARCH, 1967–1971. Kerr, A. K. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 782p. Dep. NTIS $13.60.

This bibiography is a compilation of unclassified publications of work done at the Los Alamos Scientific Laboratory (LASL) for the years 1967 through 1971. Papers published in those years are included regardless of when they were actually written. Publications received too late for inclusion in earlier compilations are also included. Declassification of previously classified reports is considered to constitute publication. All classified issuances are omitted. The bibliography includes LASL reports, papers released as non-LASL reports, journal articles, books, chapters of books, conference papers (whether published separately or as part of conference proceedings issued as books or reports) papers published in congressional hearings, theses, and U. S. patents. Papers are included in the following categories: accelerators, aerospace studies, analytical technology, astrophysics, atomic physics, biology and medicine, chemical kinetics, chemistry, cryogenics, crystallography, engineering and equipment, EPR and NMR studies, equation of state and shock studies, explosives and detonations, fission physics, health and safety, hydrodynamics and radiation transport, instruments, mathematics and computers, medium-energy physics, metallurgy and ceramics technology, molecular spectroscopy, Moessbauer effect, neutronics and criticality studies, nuclear physics, nuclear safeguards, optics and lasers, organic chemistry, physics, plasma physics, propulsion systems, reactor technology, solid state science, theoretical physics, thermionics, waste disposal, and miscellaneous. Author, report number, and KWIC indexes are included. (RWR)

12466 (LA-5458-MS) RELATIONSHIP OF SELF-FOCUSING TO SPATIAL INSTABILITY MODES. Compillo, A. J.; Shapiro, S. L.; Suydam, B. R. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

The spatial distribution of focal spots formed when laser beams self-focus in materials is shown to originate from the growth of certain instability modes. These modes are determined by a simple mathematical relationship derived from instability theory, which has been verified experimentally. Because of these instabilities, the threshold power for self-focusing is inversely proportional to the self-focusing length for high-power laser beams. (auth)

12467 (LA-tr-73-48) INVESTIGATION OF HIGH-POWER PULSED TUBULAR LAMPS BY ACTIVE ELEMENT LUMINESCENCE. Demenik, I. V.; Kozlov, N. A.; Mnuskin, V. E.; Osadchenko, V. G. Translated by Anna Vakar From Zh. Prikl. Spektrosk.; 16: No. 3, 462-466(1972). 9p. Dep. NTIS $3.00.

12468 (LBL-1534) ORIGIN OF LIFE. Calvin, M. (California Univ., Berkeley. Lawrence Berkeley Lab.). 14 Aug 1972. Contract W-7405-Eng-48. 50p. (CONF-720860-1). Dep. NTIS $4.50.

From cosmic evolution meeting; San Francisco, California, USA (14 Aug 1972).

Starting with astronomical knowledge, and in the context of modern chemistry and modern biology, a sequence of events is traced that could have taken place and one which could be a conceptual framework upon which to build further. (auth)

12469 (LBL-1816) LOW-ENERGY ELECTRON DIFFRACTION AND WORK FUNCTION STUDIES OF ADSORBED ORGANIC LAYERS ON THE (100) AND (111) CRYSTAL SURFACES OF PLATINUM. Gland, J. L. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 237p. Dep. NTIS $14.00.

Thesis.

12470 (LBL-2423) MEASURING SYSTEM FOR STUDYING THE TIME-RESOLUTION CAPABILITIES OF FAST PHOTOMULTIPLIERS. Lo, C. C.; Leskovar, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 18p. (CONF-731112-18). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A measuring system was developed for studying and optimizing the time-resolution capabilities of fast photoelectric devices, such as standard and microchannel type photomultipliers. The system incorporates a subnanosecond light-pulse generator capable of operating at repetition frequencies up to 3 MHz, with output light pulses having a full width at half-maximum of less than 200 psec, and a zero-crossing discriminator which has a time walk of ±40 psec over a 170 mV to 8 V input-pulse amplitude variation. Averaging the data from several successive measurements, the measuring system time resolution is 20 psec. (auth)

12471 (LYCEN-7307) EXTRACTION OF FLUORIDES WITH THE HELP OF SEVERAL ORGANIC ANTIMONY DERIVATIVES. Martelet, C. (Lyon Univ. (France). Institut de Physique Nucleaire). Mar 1973. 98p. (In French). Dep. NTIS (U.S. Sales Only) $7.00.

Thesis.

Possibilities of selective extraction of fluoride traces with the aid of organic antimony derivatives were studied. After a review of the fundamental characteristics of solvent extraction, the synthesis methods used are described. A systematic study was made in the presence and absence of fluorine of their hydrolysis and behavior during extraction. Although some compounds are slightly less sensitive to the influence of hydroxide than derivatives of triphenylstibine, their extraction constants with respect to fluorides are practically identical. In addition, some derivatives such as triparatolylantimony seem to possess excellent selectivity; however, low-solubility values or photochemical degradations limit their use and application to analytical problems. Triphenylantimony dichloride permits in a large range of contents (2×10^{-5} N to 10^{-2} N) the concentration and quantitative separation of fluorides contained in complex medium. (JSR)

12472 (MHSMP-71-27) DISPOSAL OF WASTE OR EXCESS HIGH EXPLOSIVES. Quarterly Progress Report, January–March 1971. Honea, F. I.; Wichman, J. E. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex. (USA)). 1971. Contract DA-11-173-AMC-487(A). 27p. Dep. NTIS $3.50.

The types of amounts of HE and HE-contaminated materials have been determined for all AEC facilities. The total amount of HE and materials destroyed annually by the AEC facilities may exceed one million pounds by 1975. During the next quarter, the amounts for each facility will be reviewed and missing information on tests will be obtained. A literature search verifies that there is very little experimental information on the gaseous products from burning or detonating of HE in air at ambient conditions. Therefore, tests are scheduled at Pantex. To determine the NO and NO_2 levels from HE detonation, a 4-ft bomb calorimeter will be utilized for containment, and two test shots will be fired for each explosive: one in vacuum and one in atmosphere. The samples will be 10-g charges of PETN, HMX, and TNT, with PETN detonators for initiation. Both mass spectrometers and gas chromatographs are available for measuring the NO_x products (as well as other detonation products). Testing is scheduled for completion during the next quarter. Similar tests of the NO_x output from burned samples are being considered. Also, for these measurements, a burning vessel has been designed and preliminary burns have been run at Burlington. Analysis methods for detecting the combustion products are now being refined. The results will be presented in a subsequent quarterly report. The Air Pollution Control Center at Durham has been contacted regarding trends in pollution requirements, and an Environmental Law Seminar at Washington provided information on new requirements of the "Clean Air Act Amendments for 1970" and the new interpretation of the 1899 Refuse Act. The present and projected requirements at the federal, state, and local levels are being assessed and will be summarized in the next quarterly report. Finally, studies of methods of disposal will be continued with the reclamation and solvent recovery methods being emphasized at Burlington and other methods being studied at Pantex. For recovery and disposal of HE some contacts will be established in the use of biological methods for digestion and possibly recovery of HE materials. The chemical relationships and potential for breakdown of HE compounds to form nitrates for fertilizer will also be investigated. In addition, increased contacts with other agencies including the DOD and EPA Solid Wastes Management Program will be established for determining potential methods of disposal. (auth)

12473 (ORNL-tr-2640) METHYL MERCURY IN NATURAL NUTRIENT CHAINS. Nuorteva, P. Translated by R. Gregg Mansfield from Naturwiss. Rundsch.; 24: No. 6, 233-243(1971). 19p. Dep. NTIS $3.00.

This extensive review directs attention to the problems of this poison both in the terrestrial and aquatic nutrient chains, with emphasis on the latter, primarily in Finland, Sweden, and Japan. The Minamata Bay disaster as well as the other catastrophic incidents in Japan are reviewed. The symptoms of Minamata disease are outlined. (LMT)

12474 (ORNL-tr-2724) CHANGE IN HEAT-RESISTANT PROPERTIES OF 12Kh1MF STEEL DURING USE. Veksler, E. Ya.; Ginzburg, E. S. Translated by M. Gerrard From Elek. Sta.; No. 8, 31-34(1972). 6p. Dep. NTIS $3.00.

The pattern of change in the heat-resistant properties of 12Kh1MF steel in the process of use is determined by the nature of the change in its microstructure and defects in the crystalline structure. The total residual creep deformation of 12Kh1MF steel pipes after 68 to 108 thousand hours of use at operating temperatures of 500 to 570°C and pressure of 4.4 to 7.4 kgf/mm^2 is lower than calculated values and does not exceed 0.5%. The probable expected value of residual creep deformation at a calculated use time of 100,000 hours under these conditions is less than 1%. With long-term use — more than 50,000 — a stabilization of the long-term strength of steel is observed. The 12Kh1MF steel studied had a rather stable structure and properties at the temperature and pressure values mentioned. Under conditions of qualitative manufacture of steel pipes it may be expected that steam conduits may be used at higher pressures and for longer times than have been calculated. (auth)

12475 (ORNL-tr-2736) PLASTIC DEFORMATION IN CRACKED PLATES OF LOW CARBON STEEL UNDER MONOTONIC TENSION AND CYCLIC TENSION-COMPRESSION. Taira, S.; Tanaka, K. Translated from Zairyo; 22: 554-549 (1973). 9p. Dep. NTIS $3.00.

12476 (ORNL-tr-2743) EFFECT OF TOPOGRAPHY ON SPREADING OF IMPURITIES WITH CONSIDERATION OF THEIR INITIAL ELEVATION. Berlyand, M. E.; Kiselev, V. B. Translated from Meteorol. Gidrol.; No. 3, 3-10(1973). 9p. Dep. NTIS $3.00.

Based on a model of potential currents, the dependence of the concentration on the ground of impurities from a source located in a hilly place with consideration of the initial rate of discharge and excess heating relative to the surrounding air was studied. The corrected multiplier obtained for earth concentrations and "dangerous" wind velocity showed a small dependence on the discharge parameters. (auth)

12477 (ORO-4199-2) THEORETICAL RESEARCH ON THE STABILITY OF THERMALLY STRATIFIED VISCOUS PARALLEL FLOW. Final Report. Gage, K. S. (Maryland Univ., College Park (USA). Inst. for Fluid Dynamics and Applied Mathematics). Aug 1973. Contract AT(40-1)-4199. 200p. (BN-778). Dep. NTIS $12.00.

This mechanism of instability studied here is often referred to as "Kelvin–Helmholtz instability" and has received much attention by meteorologists in recent years. Most of the six papers reproduced here present extensions of earlier stability analyses of bounded flows by Gage and Reid. The extension of the linear stability theory to the analysis of unbounded flows has demonstrated the importance of diffusive effects. For the stratified shear layer, instability persists with strong thermal diffusivity even though the local Richardson number exceeds 0.25 throughout the flow. In addition, a viscous mode of instability has been found for a stratified jet with self-excited disturbances possessing phase speeds lying outside the range of basic flow speed. Finally, a case study

was made of an incident of clear air turbulence to elucidate possible applications of the theory. Although the study was of interest per se, it is clear that much better measurements of atmospheric parameters will be required before conclusive comparisons can be made. The diffusive theory presented here is most applicable at very small scales (which are hard to measure) and perhaps in the upper atmosphere where diffusion effects predominate. (auth)

12478 (RFP-2090) ACOUSTIC EMISSION SOURCE LOCATION ON A NONSPHERICAL SURFACE OF REVOLUTION. Sackschewsky, V. E.; Lott, L. A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 19 Nov 1973. Contract AT(29-1)-1106. 47p. Dep. NTIS $4.00.

Described is a procedure to calculate the source location of an acoustic emission signal generated on a nonspherical surface, based on the arrival times of the signal at five transducers. The process assumes a smooth, closed surface of revolution, symmetric with respect to the equator and such that the radial distance, measured perpendicularly from the polar axis, is a strictly increasing function of the polar angle ϕ for $0° \leq \phi \leq 90°$. Listings and sample runs of the computer programs are included. The accuracy of the procedure was tested using simulated timing data for a sphere. The average distance between the true and calculated source location was 0.05% of the radius. The cycle time required to process one set of timing data is estimated to be 10 to 30 ms, depending on which version of the program is used. (auth)

12479 (SC-M-720559) STABILITY OF HIGH-TEMPERATURE-RESISTANT POLYMERS: A CRITICAL SURVEY. Arnold, C. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Sep 1973. 128p. Dep. NTIS $8.50.

Data on short-term thermal and thermoxidative stability of heat-resistant aromatic-heterocyclic polymers are compiled. Comparative stability data are highlighted and stability rankings are established. Polythiazole and several imide-heterocycle copolymers had somewhat better stability than commercially available polyimides. (58 figures, 24 tables, 154 references) (DLC)

12480 (SLA-73-564) RIGGING EQUIPMENT MANUAL: DESIGN, FABRICATION, INSPECTION, USE, AND TESTING. Stinnett, L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 42p. Dep. NTIS $4.25.

Design, fabrication, inspection, use, and testing of rigging of equipment at Sandia Laboratories are controlled by regulations set forth in Sandia Laboratories Safety Manuals and Instructions and by the provisions of the Federal Occupational Safety and Health Standards Act. This manual details requirements associated with the design, fabrication, inspection, use, and testing of rigging items such as cables, chains, ropes, slings, eyebolts, strongbacks, hooks, rings, clevises, shackles, bails, shanks, tongs, clamps, and grip plates. Rigging equipment is defined as supplementary devices used in connection with hoisting and handling. (auth)

12481 (SLA-73-890) EFFECT OF GROWTH PARAMETERS ON THE ELECTRICAL PROPERTIES AND CRYSTAL STRUCTURE OF HETEROEPITAXIAL SILICON ON SPINEL AND SAPPHIRE. Technical Report EE-207(73)SAN-254. Colclaser, R. A. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Aug 1973. Contract 51-3475-I. 30p. Dep. NTIS $3.50.

For Sandia Corp.

12482 (SLA-73-891) HOT-GAS SOLDER LEVELING ON PRINTED CIRCUIT BOARDS. Allen, T. A.; Sylvester, R. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 26p. Dep. NTIS $4.00.

Hot-gas solder leveling on printed circuit boards produces a more uniform coating in the plated-through holes than other methods, while achieving an acceptable leveling of the lands. The amount of thermal degradation to the printed circuit board by the leveling process is reduced. The working environment of the leveling machine is improved by eliminating the contaminating vapors. (auth)

12483 (SLA-73-899) PARTIAL COMPARISON BETWEEN THE SIMILARITY AND SUMMATION TECHNIQUES FOR MULTIPLE-BURST INTERACTIONS. Dahlgren, D. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 20p. Dep. NTIS $3.00.

A comparison between the similarity and summation techniques for multiple-burst interaction indicates that the similarity technique is superior for the situations considered. A model which is a substantial improvement on the shock-wave interaction test problem is suggested. Gross errors are demonstrated for the definition of a shock wave in a fireball which could impact vehicle dynamics. (auth)

12484 (SLA-73-923) OPTICAL CONTRAST ENHANCEMENT OF MOVING TARGETS. Bechtel, F. K.; Langenhorst, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 48p. Dep. NTIS $4.50.

This report discusses the idea of enhancing the contrast of moving targets by differencing time displaced optical images, relates the idea to the optical tracking problem, and discusses a laboratory implementation. Experimental results obtained with this prototype are used as the basis for recommendations for future work. (auth)

12485 (SLA-73-972) EFFECT OF TEST SYSTEM RESPONSE TIME ON INSTRUMENTED CHARPY IMPACT DATA. Hoover, W. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 20p. Dep. NTIS $3.00.

The effect of response time on instrumented Charpy impact data obtained on unidirectional Borsic–Al composites was examined. (DLC)

12486 (SLA-73-1001) TECHNIQUE FOR INTERFEROMETER SIDE GAGING MEASUREMENT OF ELECTRON-BEAM-INDUCED STRESS GENERATION IN POROUS MATERIALS AND ITS APPLICATION TO POROUS CARBON. Benson, D. A.; Ouellette, A. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 59p. Dep. NTIS $5.00.

12487 (SLA-73-1022) PARAMETRIC STUDY OF A COLD-CATHODE ELECTRON-BEAM-CONTROLLED CO_2 LASER. Hoffman, J. M.; Bingham, F. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 68p. Dep. NTIS $5.50.

Parametric studies are presented of the performance of a 10-liter atmospheric-pressure CO_2 laser system controlled by a 4-μsec pulse of electrons from a cold-cathode gun. The experimental results are compared to the predictions of a theoretical model. For various laser-gas mixtures and values of E/P, the peak small-signal-gain coefficients range up to 4.7% cm^{-1}. Measurements of gain uniformity across the laser medium and of the time dependence of the small-signal gain are also presented. Operation of the device as an oscillator over a range of parameters has shown that the output pulse typically consists of a sharp gain-switched spike followed by a longer tail, with energies up to 30 J in the spike and 200 J in the entire pulse. The theoretical model generally predicts peak small-signal gain well for gas mixtures containing nitrogen; the largest discrepancy is for pure CO_2 gas. The model also predicts the shapes of oscillator pulses satisfactorily. (auth)

12488 (SLA-73-1055) RIBBON METHOD FOR DETERMINING THE MECHANICAL PROPERTIES OF FILAMENTS. Ericksen, R. H.; Swearengen, J. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 16p. Dep. NTIS $3.00.

A ribbon test method was established which uses strain gages. Stress-strain, modulus, and creep measurements were made using several techniques to verify the method. The method eliminates compliance calibration and facilitates measurements of small strains in filaments having very high stiffness. (auth)

12489 (UCID-16364) NEW TRANSIENT SURFACE-CURRENT SENSOR AND RECORDER. Hsieh, E. J.; Vindelov, K. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1973. Contract W-7405-Eng-48. 14p. Dep. NTIS $3.00.

It was demonstrated that a transient surface-current pulse can be sensed and recorded by a graded-Hc film, a magnetic film with the coercive force Hc varying along the length of the film. Information on the magnitude of the current can be obtained by comparing the domain-wall location with the distribution of Hc value along the film. The transient characteristic of the current pulse can be deduced from the V-shaped configuration of the domain wall. (auth)

12490 (UCID-16378) INDUSTRIAL MOVE TO SI AND THE LIVERMORE PLAN. Pearson, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1973. Contract W-7405-eng-48. 20p. Dep. NTIS $3.00.

The role of U. S. industry in moving the nation to metric measurements and the attendant benefits to the nation are discussed. (MOW)

12491 (UCRL-74365) DIFFUSION PATH NETWORKS IN THE WURTZITE LATTICE. Condit, R. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1973. 13p. (CONF-730956-2). Dep. NTIS $3.00.

From Battelle colloquium on defects in oxides; Columbus, Ohio, USA (17 Sep 1973).

Cation jump possibilities between interstices in structures where the anions are in hexagonal close packing are described, with emphasis on the wurtzite lattice (BeO and ZnO) where diffusion

in the a- and c-directions is the same. Two types of vacancy mechanism give D_c/D_a = 1.3 and 1.5, and an interstitialcy mechanism gives 1.0; interstitial diffusion can be ruled out. (DLC)

12492 (UR-3490-406) EFFECT OF COMBINED EXPOSURE TO METHYLENE CHLORIDE AND ETHANOL IN GUINEA PIGS. Balmer, M. F. (Rochester Univ., N. Y. (USA)). 1973. 37p. Dep. NTIS $4.00.

Thesis.

One- and five-day studies of the inhalation of methylene chloride and of ethanol, singly and in combination were performed in guinea pigs. Liver triglyceride levels, percent carboxyhemoglobin and histology were the parameters observed. The one-day exposure to 11,100 ppM of methylene chloride and 25,100 ppM of ethanol in combination prevented an increase in the triglyceride level and in histological change as seen by methylene chloride alone. Exposure to the TLV (500 ppM) of methylene chloride alone and in combination with 25,100 ppM ethanol did not effect triglyceride levels or histological change. Five-day exposures to the combined agents showed no antagonistic effects. The triglyceride level in five-day exposure to the TLV of methylene chloride with 25,100 ppM of ethanol was not statistically different from only methylene chloride, but there was a suggested increase. The histological change was greater and there was one death. Carboxyhemoglobin levels were elevated upon one-day exposure to methylene chloride, but not in the 5-day or combined exposures. The one-day LC_{50} for methylene chloride in guinea pigs was approximately 11,600 ppM. (auth)

12493 (Y-1926) ACOUSTIC EMISSION ENERGY TO PULSE-HEIGHT CONVERTER. Speller, B. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 18 Dec 1973. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

An energy-to-pulse-height converter was developed for use in acoustic emission testing. This instrument accepts an amplified signal from a piezoelectric crystal and generates a pulse whose amplitude is proportional to either the energy or width of the input signal. Either linear or logarithmic responses can be selected. Theory, circuit design, and performance specifications have been determined, based on calculations and measurements. (auth)

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